SCIENCE ABSTRACTS.

Section A.—PHYSICS.

AUGUST, 1928.

GENERAL PHYSICS.

2023. New Method for the Absolute Determination of *g* by the Pendulum. C. Volet. *Comptes Rendus*, 186. *pp.* 1044–1046, *April* 16, 1928.

If a pendulum consists of a part rigidly fixed to the knife-edge and a part which can move, then, if the distance of this mass from any origin is x, the period T is given by $T^2 = (A + Bx + x^2)/(C + Dx)$, where $D = g/4\pi^2$. By observing T for a large number of x's, A, B, C and D can be determined by least squares. The proposed method has the advantages that the same knife-edge is used throughout, and the effects of its "bluntness" cancel out; it is also subjected to the same weight throughout.

W. G. B.

2024. Various Methods employed in Calculating Pendulum Corrections. G. Bigourdan. *Comptes Rendus*, 186. *pp.* 1245–1247, *May* 7, 1928.

Since the successive corrections to a pendulum, observed astronomically, depend on the weather and are therefore irregular, but signals (such as B.I.H.) must be sent out regularly, the actual corrections applied must be calculated from its rate. The author describes the usual methods employed in the case of a master pendulum and its attendants, and shows that his own method is much more exact. In this he examines by some means, before any calculation is made, hour by hour the rate of each pendulum, whilst using their mutual comparisons so as to show momentary irregularity in any one of them, which might affect the exact time for the signal, this being the essential object.

A. S. D. M.

2025. Shortt Clocks at the Royal Observatory, Greenwich. J. Jackson and W. Bowyer. *Roy. Astron. Soc., M.N.* 88. *pp.* 465–481, *March*, 1928. *Nature*, 121. *pp.* 868–870, *June* 2, 1928.

The clocks Shortt 3 and 11 are examined. Their principal irregularities in the year 1927 can be explained by a secular change in the period of oscillation and by a temperature effect (this latter is unexpected in Shortt clocks). The authors discuss five possible sources of the irregularities, but one of these only is important and is due to the length of the rod, whose material (invar) is unstable.

A. S. D. M.

2026. Practical Accelerograph. O. Devik. *Phys. Zeits.* 29. *pp.* 308–311, *May* 15, 1928.

An instrument is described which is designed to measure vertical accelerations of the order 100 cm./sec.^{2} A recording cylinder is supported by a horizontal spring so that its axis is vertical, and the heavy mass of the cylinder provides the inertia by means of which accelerations are determined. The vertical motion of the cylinder is made aperiodic by oil-damping, and the instrument can be calibrated by employing a known acceleration such as may be obtained by using a spring pendulum of known period. The method of calibration and the construction and working of the accelerograph are fully described. G. E. A.

2027. Control Unit for Electrically Heated Mercury Vapour Pumps. D. R. Barber. *Journ. Sci. Instruments*, 5. *pp.* 133–134, *April*, 1928.

A simple type of heater control is described, designed for use with all types of mercury vapour pumps equipped with electric heaters.

AUTHOR.

2028. Calibration of a McLeod Gauge. R. J. Clark. *Journ. Sci. Instruments*, 5. *pp.* 126–130, *April*, 1928.

A method of construction of a gauge of long range is described and also a method of correcting for the error due to the meniscus in the capillary tube by shifting the whole scale of the instrument. AUTHOR.

2029. Instrument to Record the Carbon Dioxide Content of a Gaseous Mixture. K. Gordon and J. F. Lehmann. *Journ. Sci. Instruments*, 5. *pp.* 123-126, *April*, 1928.

The carbon dioxide recorder described is based on the variation in concentration of the bicarbonate salt in equilibrium with a saturated solution of the carbonate of an alkaline earth, preferably barium. The bicarbonate concentration is dependent upon the carbon dioxide partial pressure in the gas passed through the solution, and is measured by determining the electrolytic conductance of the solution. By using a recording a.c. milliammeter to measure this conductance a continuous record is obtained of the carbon dioxide in the gas. The readings of the instrument are independent of the gaseous constituents other than carbon dioxide. It can therefore be used when other recorders are inapplicable owing to the simultaneous variation of several constituents of the gas to be analysed.

AUTHORS.

2030. Recording Gyroscope. G. F. C. Searle. *Cambridge Phil. Soc., Proc.* 24. *pp.* 236–250, *April*, 1928.

A gyroscope for experimental work in a physics laboratory is described and its use explained. A set of experimental results is given. W. G. B.

2031. Damping for Gyro-Compasses. O. Martienssen. *Phys. Zeits.* 29. *pp.* 295–300, *May* 15, 1928.

Describes a new method of damping out the oscillations of a gyro-compass. A small weight is placed on the edge of a disc attached to the moving system and parallel to the compass card. This weight is placed at the east side of the disc and the small out-of-balance force produces an effective damping of the oscillations. The theory of the method is treated mathematically. J. W. T. W.

2032. Condensation Hygrometer. L. Martinozzi. *Accad. Lincei, Atti*, 7. *pp.* 389–393, *March* 4, 1928.

Ranzi has found that in the ordinary type of condensation hygrometer there is a difference of a degree Centigrade between the outside of the condensation bulb and the thermometer bulb inside it. The author has replaced the mercury thermometer by a metal thermometric arrangement. A. D.

2033. Application of the Brunsviga-Dupla Calculating Machine to Double Summation with Finite Differences. L. J. Comrie. *Roy. Astron. Soc., M.N.* 88. *pp.* 447–459, *March*, 1928. A. S. D. M.

2034. Weight of Aircraft Structures. G. A. Crocco. *Accad. Lincei, Atti*, 7. *pp.* 273–278, *Feb.* 19, 1928.

Examines the theoretical limits to the weight of a structure intended for aerial navigation. The author concludes that the minimum weight of a skeleton structure is equal to the sum of the products of the breaking stresses of the rods and the relative distances apart of the joints, multiplied by a numerical coefficient depending on the properties of the material. Starting from this principle he deduces rules for a plane structure subject (*a*) to parallel forces in equilibrium, and (*b*) to a torsion, assuming in each case the most favourable arrangement of the material. J. W. T. W.

2035. Mean Values of Straight and Curved Chords of Geometric Bodies. P. Clausing. *K. Akad. Amsterdam, Proc.* 30. 8. *pp.* 860–863, 1927.

The theorem considered here is important in certain gas diffusion problems. A special case arises in dealing with the movement of molecules in cylindrical tubes on the assumption that they do not collide with each other and that they leave the walls according to the cosine law. The general form of the theorem may be stated as follows: The mean chord of a " body " with " volume " V_m and " area " S_m in an m – dimensional space is given by

$$\bar{\rho}_m = \lambda_m \frac{V_m}{S_m},$$

with

$$\lambda_m = \frac{1.\ 3.\ 5.\ \ldots\ (m-1)}{2.\ 4.\ \ldots\ (m-2)}\,\pi$$

for even m, and

$$\lambda_m = \frac{2.\ 4.\ 6.\ \ldots\ (m-1)}{1.\ 3.\ 5.\ \ldots\ (m-2)}\,2$$

for odd m. A. A. D.

2036. Hypothetical Model for the Kinetic Theory of Solid Bodies. L. Prandtl. *Zeitz. f. angew. Math. u. Mechanik*, 8. *pp.* 85–106, *April*, 1928.

A model is described for the representation of form change so that hysteresis, elastic after-effect, and dependence of flow stress on flow velocity are in good agreement with observation. In addition, regularities are given for temperature dependence which enable the entire transition from solid body to liquid state to be followed. In the case of liquid viscosity, a valid dependence upon temperature and pressure is given. Phenomenonological expressions are derived and an application of the formulæ is made to the case of sliding friction. H. H. Ho.

2037. Elasticity. G. Krall. *Accad. Lincei, Atti,* 6. *pp.* 488–492, *Dec.* 4, 1927.

A mathematical discussion of the Green-Somigliana tensor in equations of elasticity and its functional dependence upon the contour. E. E. F. d'A.

2038. Two-Dimensional Problems in the Theory of Elasticity. M. Sadowsky. *Zeits. f. angew. Math. u. Mechanik,* 8. *pp.* 107–121, *April,* 1928.

It is shown that the general solution of plane problems in the theory of elasticity can be expressed in terms of two pairs of conjugate functions. When the boundary conditions are in terms of stress or strain alone, the solution can generally be found by Fourier analysis, as is shown in detail for the semi-infinite plate. When the boundary conditions are "mixed" (as when the displacement is known over some portions and the stress over the others), they give rise to an integral equation. An investigation of three-dimensional solutions having helicoidal symmetry is also given.

W. G. B.

2039. Stability of Elastic Prismoidal Bars under Thrust. M. Broszko. *Comptes Rendus,* 186. *pp.* 1041–1043, *April* 16, 1928.

Euler's formula, and that of Karman for stresses above the elastic limit, take no account of the compression of the bar. This is done here, and the formula deduced is $P_{cr} = \pi^2(1 - e_{cr})E_{cr}I/l^2$, where e_{cr} is the longitudinal strain under the critical load P_{cr}, and E_{cr} = critical stress/e_{cr}, which can be found by successive approximations if the stress-strain curve is known. **Errata** (*ibid.* p. 1586, June 4, 1928). W. G. B.

2040. Calculation of Certain Elastic Deformations, with their Application to the Plane Spiral. J. Haag. *Compes Rendus,* 186. *pp.* 1194–1196, *May* 7, 1928.

If a system of forces be applied to an elastic body, and the displacements depend upon n parameters, $q_1, q_2, \ldots$, the strain energy function W will be a quadratic function of the q's. If $Q_r = \partial W/\partial q_r$, W is also a quadratic function of the Q's, and $q_r = \partial W/\partial Q_r$. For a spiral, fixed at one end, and with a force and/or couple applied to the end, W is easily calculated in terms of these, and so formulæ for the end deflection are obtained. W. G. B.

2041. Equations of Elastic Surfaces with Three Parameters. L. Roy. *Comptes Rendus,* 186. *pp.* 1081–1083, *April* 23, 1928.

Discusses these surfaces on the same lines as previously for those of six parameters [see Abstract 1445 (1928).] W. G. B.

2042. Intrinsic Equations of Elastic Surfaces of Three Parameters. L. Roy. *Comptes Rendus,* 186. *pp.* 1251–1253, *May* 7, 1928.

By these equations are meant those obtained by taking as axes of projection not the fixed ones O xyz but the movable M uvw. By a suitable choice of these axes certain rotations are rendered negligible and thereby do not enter into expressions for the internal thermodynamic potential and the dissipative function. Other results are briefly referred to.

H. H. Ho.

2043. Theory of Torsional Oscillations in Plastic Solids. J. P. Andrews. *Phil. Mag.* 5. *pp.* 865–880, *May,* 1928. *Supplement.*

The equations of motion of a torsional pendulum, the suspending wire being of plastic material, are investigated empirically. A second form of the equations based on the assumption that the rate of plastic flow is proportional to an odd power of the elastic stresses is shown to afford an explanation of the observed dependence of logarithmic decrement upon amplitude. J. S. G. T.

2044. Dissociation Pressure and Size of Grain. M. Centnerszwer and J. Krustinsons. *Zeits. f. phys. Chem.* 132. *pp.* 185–188, *March,* 1928.

Carbonate of lead prepared in different sizes of grain by different processes differs in the dissociation pressure. The superficial tension in the solid-gas boundary is in the neighbourhood of 63,000 dynes/cm.^{2}. A. D.

2045. Slow Stationary Motions of Liquid Viscous Films. B. Finzi. *Accad. Lincei, Atti,* 6. *pp.* 481–487, *Dec.* 4, 1927.

Shows mathematically that the slow stationary motion of a viscous liquid film depends only upon the conditions at the edges, so that the motion will be the same on two surfaces applicable to each other, and also in a developable surface as compared with a similar plane surface. E. E. F. d'A.

2046. Second Approximation to the "Oseen" Solution for the Motion of a Viscous Fluid. L. N. G. Filon. *Roy. Soc., Phil. Trans.* 227. *pp.* 93–135, *March* 2, 1928.

In a recent paper [see Abstract 535 (1927)] the author obtained expressions for the forces on a stationary cylinder in a steady stream of incompressible viscous fluid and showed that the force transverse to the stream followed the well-known Kutta-Joukowski law, whereas in the direction of the stream there is involved an outward radial flow, compensated by an intake along a "tail" behind the cylinder. The present paper investigates the second order approximation when the terms of second order in the velocities of disturbance are neglected neither in the equations of motion nor in the integrals giving the forces. It appeared that terms of the second degree must be retained in the torque, even when only terms of the first order are retained in the solution of the equations, so that an attempt has been made to obtain the torque, as well as the forces, on the cylinder. A remarkable result emerged in that one of the second order terms led to an integral physically impossible; nevertheless, confirmation of its validity was obtained by an alternative method, so that only two conclusions appear possible, *viz.*, that rigorously steady motion is impossible, or that the "Oseen" form of the equations is unsuitable as a first approximation upon which to base further developments, and that successive approximations should be based upon a different form, a type of which is now suggested. H. H. Ho.

2047. Operational Solution of Some Problems in Viscous Fluid Motion. A. F. Crossley. *Cambridge Phil. Soc., Proc.* 24. *pp.* 231–235, *April,* 1928.

Obtains, by operational methods, the solutions of the problems solved otherwise by Havelock [see Abstract 443 (1922)]. W. G. B.

2048. Discontinuous Fluid Motion Past an Elliptic Barrier. C. A. Ford. *Leeds Philosoph. and Lit. Soc., Proc.* 1. *pp.* 209–216, *April,* 1928.

Detailed numerical investigation of Brodetsky's solution for discontinuous motion past (approximately) elliptic barriers. W. G. B.

2049. General Fluid Motion Round a Contour. E. Carafoli. *Comptes Rendus*, 186. *pp*. 1196–1198, *April* 30, 1928.

If the space outside the contour can be conformally represented in the space outside a circle, the velocity-potential-stream function for a motion consisting of circulation, translation and rotation can be constructed with comparative ease. The result for the Joukowski aerofoil is given, along with the force and moment of the fluid pressures. W. G. B.

2050. Influence of Vortices upon the Resistance Experienced by Solids Moving through a Liquid. W. G. Bickley. *Roy. Soc., Proc.* 119. *pp*. 146–156, *May*, 1928.

Two cases of two-dimensional streaming past a cylinder with vortices present are worked out in detail. In the first, with two symmetrical vortices, the resultant is a force in the line of motion; in the second, with one vortex and circulation, the force is inclined to the direction of motion. "Lift" and "drag" are calculated, and the lift-drag curves show a resemblance to those found experimentally for the Flettner rotor. W. G. B.

2051. Boundary Roughness and Thermal Exchange in Stream Theory. H. Lorenz. *Phys. Zeits.* 29. *pp*. 301-302, *May* 15, 1928.

Previous publications have dealt separately with roughness and thermal exchange in stream problems [see Abstract 2567 (1927)]. The present mathematical note considers the motion of a solid through a liquid and shows how results for this case may be obtained by flow experiments through tubes. The economy thus effected in applications to conditions of ship motion may become of great importance. H. H. Ho.

2052. Theory of the Spontaneous Division of Microscopic Drops. Part II. N. v. Raschevsky. *Zeits. f. Phys.* 48. 7–8. *pp*. 513–529, 1928.

The author refers to earlier work [see Abstract 793 (1928)] in which he investigated the initial conditions regarding the concentration of dissolved substances in a drop which would suffice for the drop to grow by precipitation of its substance from the surrounding phase and for the drop eventually to subdivide. These initial conditions are traced back to a boundary problem on a surface deformed in a prescribed way with time. The case is then investigated where the velocity of the diffusion processes is very large in comparison with the rate of growth of the drops and where chemical changes in the drop also occur. In drops of a certain size a corresponding quasi-stationary distribution of concentration arises. The constitution of the drop depends then on its size, and the surface tension particularly is a special function of the radius of the drop. These circumstances are illustrated in a numerical example. Certain general considerations for drops existing over many phases are dealt with, and it is shown that while the single-phase drop will increase to a certain size and then subdivide, this series of operations being repeated successively for the new drops, this is not in general the case for two-phase drops. R. S. R.

2053. Brownian Displacements and Thermal Diffusion of Grains suspended in a Non-Uniform Fluid. S. Chapman. *Roy. Soc., Proc.* 119. *pp*. 34–54, *May* 1, 1928.

The object of the paper is to extend the results obtained by Einstein

[Abstract 743 (1906)] on the Brownian motion of grains suspended in a stationary uniform fluid (liquid or gaseous) to the more general case of a non-uniform fluid. The non-uniformity may refer to temperature, composition, or any other property which affects the coefficient of diffusion (D) of the grains in the fluid. The distribution function obtained is for the case of small spherical grains whose mutual distances are large enough in relation to their own dimensions for their thermal motions to be independent of one another to a sufficient degree of approximation. This function includes terms additional to those given by Einstein for the uniform case; certain of these are definitely determined, but another important term contains a coefficient not zero in general, but which is assumed to be zero for Brownian grains large compared with the mean free path of the molecules in the fluid. The steady distribution of grains in a fluid is determined when the temperature (T) of the fluid is non-uniform, both when the grains are of the same density as the fluid and when there is a difference of density, so that the grains are acted on by differential gravity. In the former case the concentration (n) is found to vary inversely as D; D varies with the temperature more rapidly in liquids than in gases, and in the case of a Maxwellian gas D is independent of temperature, so that Brownian thermal diffusion, like true gaseous thermal diffusion, does not operate in such a gas. In other cases the grains are most concentrated in the coldest regions. When the grains have not the same density as the fluid, it is shown that with a uniform temperature gradient nD is not constant, as in the former case, but varies as a power of T. The order of magnitude of the various effects is estimated numerically, and an outline is given of the way in which they could be confirmed experimentally. R. S. R.

2054. Molecular Displacements in Diffusing Gas Mixtures. S. Chapman. *Roy. Soc., Proc.* 119. *pp.* 55–60, *May* 1, 1928.

The author applies in the present paper his general results regarding thermal diffusion of grains in a non-uniform fluid [see preceding Abstract]. These earlier equations did not depend on the nature and number of the particles considered, nor on the nature of the surrounding medium, provided that (1) the particles retain their individuality, neither breaking up nor combining with others; (2) no boundary effects are considered; and (3) a small minimum interval τ_0 exists such that in successive intervals τ_0, the displacements of any particle are independent. In gases this interval is obtained since the frequency of collision is so large. The results are then applied to obtain equations for gas mixtures. It is shown that if the molecules are rigid elastic spheres, any particular cluster of molecules will, when spreading outwards, move towards the hot or cold regions, depending upon whether the rare molecules are lighter or heavier. In gas mixtures where the concentration is small the previous result obtained, $n_1 \alpha 1/\mathrm{D}_{12}$, no longer holds, and the concentration gradient set up by thermal diffusion exceeds this value. R. S. R.

2055. Fourier Constants. E. T. Copson. *Roy. Soc. Edinburgh, Proc.* 48. 1. *pp.* 15–19, 1927–1928.

2056. Fourier Expansions of $(1 + a^2 - 2ak\cos\psi)^{-s}$. E. W. Brown. *Roy. Astron. Soc., M.N.* 88. *pp.* 459–465 *March*, 1928.

2057. Periodic Solutions of Hamiltonian Systems of Differential Equations. T. M. Cherry. *Roy. Soc., Phil. Trans.* 227. *pp.* 137–221, *April* 23, 1928.

Contents.—§ 1. Comparison with former theories of periodic solutions. § 2. Ordinary and singular periodic solutions. § 3. Lagrange brackets and contact transformations. § 4. The exponents of a periodic solution. § 5. Transformation of the equations. § 6. Periodic solutions when λ, ν are incommensurable. § 7. Periodic solutions when λ, ν are commensurable and $\lambda \neq 0$. § 8. Example illustrating the theory of §§ 5, 7. § 9. Periodic solutions when $\lambda = 0$. §10. Direct construction of periodic solutions in the neighbourhood of a known periodic solution. Convergence of the series. § 11. Transformation of the variational equations to normal form. § 12. Periodic solutions in the neighbourhood of an equilibrium solution. § 13. Variation of periodic solutions with an arbitrary parameter μ on which the equations depend. § 14. Totality of all regular periodic solutions possessed by a given Hamiltonian system.

2058. Remarks on Current Functions. D. Riabouchinsky. *Comptes Rendus,* 186. *pp.* 1276–1278, *May* 7, 1928.

The relation $\phi + \epsilon\psi = f(x + \epsilon y)$, where $\epsilon^2 = -a$, is taken as a possible generalisation of functions of a complex variable. With $f(z) = \mathrm{U}(z + c^1/z)$, we obtain a rotational motion, with a boundary which is an ellipse, two straight lines, or a hyperbole according as a is positive, zero or negative, and velocity U at infinity. If ϕ from the above is used in the equations of viscous motion, they are integrable if the inertia is anisotropic ($\rho_y = a\rho_x$). W. G. B.

2059. Notes on Dynamics. Interference. A. Proca. *Comptes Rendus,* 186. *pp.* 1097–1099, *April* 23, 1928.

In a previous note [see Abstract 1468 (1928)] the author has drawn attention to the logical necessity of completing the dynamics of the material point by the introduction of a new coordinate λ. Application is now made to the dynamics of a photon, and it is found that the period of the variable λ should be equal to an integral number of wave-lengths of the light which constitute the photons. The phenomena of diffraction *in vacuo*, interference by reflection, and all similar cases where the speed of the photon has a constant value are then considered. The results show that the theory of quanta itself demands the periodicity of the light. H. H. Ho.

2060. Polychroism and Orientation of Ions. R. Brunetti. *Accad. Lincei, Atti,* 7. *pp.* 238–244, *Feb.* 5, 1928.

The absorption-polychroism of crystallised salts of the rare earths gives evidence of the orientation of an axis connected with the structure of the ions in respect to the direction of symmetry of the crystalline structure. A. D.

2061. Ratio between the Surface Energies of Different Surfaces of Rock-Salt Crystals. S. Arzybischew. *Zeits. f. Phys.* 48. 3–4. *pp.* 286–287, 1928.

Contains remarks on papers by Kusnezow and Bessonow [see Abstracts 2450 and 3039 (1927)]. The author considers the assumption that the work required to grind the different faces of the crystals is proportional to the surface energies of these faces rests on a very uncertain basis, since in addition to splitting off minute particles work is used in grinding up these particles; besides this it would be necessary to assume that the mean linear dimensions of the particles are inversely proportional to the surface energies. Records some experiments in which the coefficients of friction and the ratio between the work required to grind the (100) and (110) surfaces were determined. The values obtained differ greatly from those of Kusnezow and Bessonow. H. N. A.

2062. Characteristic Infra-Red Vibrations of Certain Crystals of the Rock-Salt Type. L. J. Carpenter and L. J. Stoodley. *Phil. Mag.* 5. *pp.* 823–832, *May,* 1928. *Supplement.*

Using the force constants for the ions in the crystals deduced by Lennard-Jones [see Abstract 46 (1927)] the authors calculate the frequency of the above vibrations in NaCl, KCl, KBr and KI, assuming that the two oppositely charged ionic lattices vibrate as wholes relatively to one another, that the restoring force is proportional to the first power of the displacement, and that the restoring force on an ion depends on the fourteen nearest ions of opposite sign. The following table gives the calculated wave-lengths, those obtained by Born and Brody, using density and compressibility data, and the wave-lengths of the residual rays determined by Rubens:—

	Calculated.	Born and Brody.	Residual Rays.
NaCl	45·9 μ	61·6 μ	52·0 μ
KCl	66·4	74·5	63·4
KBr	90·5	88·0	82·6
KI	99·5	108·3	94·1

The authors' value for NaCl is evidently too low, as it is less than that of the residual ray, while theoretically it should be greater, as in the other cases; for rubidium chloride the calculated wave-length of the characteristic vibrations is 82·9 μ, Reinkober's value for the residual rays being 74 μ. H. N. A.

2063. X-Ray Analysis and Crystalline Structure of Cadmium-Silver Alloys. Part III. G. Natta and M. Freri. *Accad. Lincei, Atti,* 7. *pp.* 406–410, *March* 4, 1928.

X-ray analysis by the powder method of cadmium-silver alloys rapidly solidified and tempered [see Abstract 1477 (1928)] reveals the existence of a region of α-solid solutions of cadmium in silver having the lattice of the latter deformed regularly according to Vegard's law up to 35 % of cadmium; the α-phase is found in alloys containing from 0 to about 45 % of cadmium, and the side of the elementary cell increases from 4·07 to 4·15 Å. A compound AgCd exists with a body-centred cubic lattice and capable of forming with the components β-solid solutions present in alloys with 47 to 55 % of cadmium; the elementary cell, of side increasing from 3·32 to 3·34 Å., contains one molecule, and the calculated density is 9·97–9·82. The alloys containing from 55 to 65 % of cadmium are composed of solid solutions of a new phase having a complex structure, similar to the centred body, with cubic elementary cell of side 9·96 Å. containing 52 atoms, *i.e.*, 4 molecules of the compound Ag_5Cd_8. From 65 to about 95 % of cadmium a type of simple compact hexagonal structure occurs with $c : a = 1 \cdot 58$ and with side varying from 3·04 to 3·09 Å. Such alloys appear to represent ideal solid solutions of cadmium and silver in the compound $AgCd_3$; the dimensions of the elementary cell of this compound, probably a multiple of 3·07 Å., cannot be determined exactly, since the cadmium and silver atoms have only slightly different atomic weights. For the same reason it is difficult to establish whether there is regular distribution of the atoms of the solute metal in these alloys. Alloys containing 95 to 100 % of cadmium are composed of solutions of silver in cadmium, having the lattice of the latter. On reheating, transformation is observed only for the β-alloys. The compound AgCd is dimorphous, and changes below 420° into a compact hexagonal modification with $c : a = 1 \cdot 62$ and $a = 3 \cdot 01$ Å. At temperatures below 200° some solid solutions of the compound AgCd become unstable and are transformed into a mixture of the α- and γ-phases. A close analogy in crystalline structure exists between copper-zinc and silver-cadmium alloys, all the phases present in tempered silver-cadmium alloys occurring, with similar lattices, in the brasses. T. H. P.

2064. Determination of the Crystal Structure of the Alkali Metals and of Strontium. F. Simon and E. Vohsen. *Zeits. f. phys. Chem.* 133. 3–4. *pp.* 165–187, *April*, 1928.

The authors point out the many difficulties involved in a determination of this nature, as, for example, the high reactivity and ready oxidation of these metals. The chief obstacle, however, for a structure analysis determination following the method of Debye is that at room-temperature these metals do not show a fine crystalline structure; not only in the neighbourhood of the melting-point, but already at room-temperatures, the atomic vibration is so large that the crystalline state is quickly passed. These reasons explain why earlier Röntgen-ray researches in this direction gave results of small value. The authors describe in detail their specially constructed Debye camera which is used at 100° Absolute. Thin foil of sodium, potassium, rubidium, calcium, and even lithium were investigated according to the method of Debye-Scherrer. The cubic space lattices of the five alkali metals have the following lattice constants at 100° Absolute: Li, $a_{100} = 3 \cdot 46$ Å.; Na, $a_{100} = 4 \cdot 24$ Å.; K, $a_{100} = 5 \cdot 25$ Å.; Rb, $a_{100} = 5 \cdot 62$ Å.; Cs, $a_{100} = 6 \cdot 05$ Å. The atomic volumes calculated from the lattice constants on comparison with those obtained by the help of the Grüneisen formula from the density values at room-temperatures show good correlation. The atomic volumes and densities at absolute zero are also determined by the Grüneisen relation. The cubic space lattices for sodium and potassium are shown to be the same for room-temperatures as for liquid air. Strontium in thin foil at room- and liquid air-temperatures has a cubic space lattice with a lattice constant of $a_{100} = 6 \cdot 03$ Å. Calcium as thin foil is shown to give at room-temperatures the well-known cubic space lattice. The Röntgen diagrams for zinc and cadmium at room- and higher temperatures are also given and are fully discussed. J. K.

2065. Structure of Cyanite, Al_2SiO_5. W. H. Taylor and W. W. Jackson. *Roy. Soc., Proc.* 119. *pp.* 132–146, *May* 1, 1928.

The structure is deduced mainly from a semi-qualitative comparison of the intensities of spots in rotation photographs, guided by the previous results of W. L. Bragg and West for other silicates [see Abstract 24 (1928)]. The crystal is triclinic, space group C_2^1. The axial lengths are $a = 7 \cdot 09 \pm 0 \cdot 02$ Å., $b = 7 \cdot 72 \pm 0 \cdot 04$ Å., $c = 5 \cdot 56 \pm 0 \cdot 02$ Å. Angles $\alpha = 90° 5\frac{1}{2}'$, $\beta = 101° 2'$, $\gamma = 105° 44\frac{1}{2}'$. The axial lengths a and b differ appreciably from those given by Mark and Rosbaud. The unit cell contains four molecules of Al_2SiO_5. The measurements indicate that the structure approximates closely to the following ideal pattern: Oxygens in cubical close packing, silicons and aluminiums uniformly distributed in the interstices, with each silicon and aluminium at the centre of a group of 4 and 6 oxygens respectively. The tetrahedral SiO_4 groups are entirely distinct from one another (*i.e.*, without shared oxygen atoms), as in Mg_2SiO_4, etc. The actual structure is represented by a slight distortion of this ideal pattern. The proposed structure satisfactorily explains the cleavages of cyanite and the marked variation of the hardness as measured in different directions on the (100) face. H. R. R.

2066. Scattering Law of the Free Lattice and the Statistical Bearing of the Nodes and Loops of the Lattice Spectrum on the Interference of Plane Characteristic Waves. A. Wintner. *Zeits. f. Phys.* 48. 7–8. *pp.* 495–512, 1928.

Sketches a direct theory of oscillations in a lattice, which is carried mathematically further than in the usual methods of treatment, and is adapted to throw new light on the physical side of lattice dynamics, optical and acoustical spectra, the group movement of plane waves and resonance points, etc. The algebraical results of the methods of Born and Karman follow directly and explicitly from the new theory. Amongst other things an exact foundation has apparently been obtained for the lattice theory of specific heat. The paper deals mainly with lattices such as that of rock-salt, which have a Laurent matrix, and the Toeplitz theory of these matrices is employed in obtaining the law of dispersion of the free lattice; in the last paragraph the most general lattice matrix, which is not of the Laurent type, is considered, and it is shown how such lattices can be dealt with. It is noted as interesting that lattice dynamics requires the mathematical apparatus which forms the basis of matrix mechanics.

H. N. A.

2067. Determination of the Orientation of Aluminium Monocrystals by an Optical Method. J. Weerts. *Zeits. f. tech. Phys.* 9. 4. *pp.* 126–136, 1928.

When the above crystals are suitably etched, first with hydrofluoric and then with hydrochloric acids, minute, highly reflecting surfaces are produced parallel to the cube surfaces, so that when a parallel beam of light falls on the crystal it appears very brilliant in certain positions. Bridgman has devised a method for determining the position of the crystal axis by these means. The author describes another method, which depends on an observation by Sachs of the behaviour of these etched crystals when viewed between crossed Nicols with a gypsum plate giving a red colour; some of the facets reflect a very bright red, which does not change its tint when the specimen is rotated about the direction of observation, these facets are the cube faces and others change in colour when rotated. The apparatus described makes it possible to adjust the crystal under examination with great accuracy, so that the polarised light falls exactly perpendicularly on one of the sets of facets; if it is rotated about this direction, the intensity and tint remain the same. The thickness of the gypsum plate is in this apparatus such as to give a sensitive violet tint. The crystal holder is provided with a Kardan mounting, so that the orientation can be measured. Details are given of the results obtained with a number of crystals. An improvement of the Bridgman method is described. The results obtained are compared with those arrived at by X-ray methods. H. N. A.

2068. New Graphical Appliance for the Interpretation of Rotation Diagrams of Crystals. W. Büssem and K. Herrmann. *Zeits. f. tech. Phys.* 9. 4. *pp.* 148–154, 1928.

The apparatus consists of three sliding scales for the *h*, *k* and *l* values, placed one above another, and a fixed scale along which the lowest of the three slides. From the points of the fixed scale are traced on a board below it a series of curves, which give the relation betwen $\sin^2 \theta/2$ and the film coordinates. The authors describe the construction and use of the scales and curves. When the cursor which moves over the curve board is placed in the position corresponding to a point in the rotation diagram, and the sliding curves are properly manipulated, more or less exact coincidences between the *h*, *k* and *l* marks indicate the values of *h*, *k* and *l* for the point in question. The points photographed can be identified with very great rapidity and much laborious calculation is saved. H. N. A.

2069. Crystalline Liquid State as a General Property of Matter. P. P. v. Weimarn. *Kolloid Zeits.* 44. *pp.* 279–288, *April*, 1928.

This first part of the paper bears the sub-title: Vectorial Aggregation, Fluidal Structures and Stream Flow Double of Barium Sulphate Crystals. The experiments were begun in 1905. More than 100 materials have been obtained in the state of coarse-celled jellies. The cell walls consist of crystalline matter, at first too small even for ultramicroscope vision, which retains mobility and tends to vectorial chain formation under stresses which lead to a distinct aggregate polarisation between crossed nicols. Depolarisation by finely-powdered quartz was already observed by Babinet. The author prepares his precipitates of $BaSO_4$ by superposing on the microscope stage a drop of $Ba(SCN)_2$ solution upon a drop of $MnSO_4$ or $CoSO_4$. The photographic plates are reproduced and the phenomena are discussed with reference to Quincke, Friedel, and Zocher. The nature of the precipitates depends more upon the conditions of the precipitation than upon the individual properties of the substances. H. B.

2070. Boundary Effects in the Structure of Anisotropic Liquids. W. Kast. *Phys. Zeits.* 29. *pp.* 293–295, *May* 15, 1928.

According to Zocher [see Abstract 547 (1928)] the molecules of anisotropic liquids would all lie in parallel orientation. According to the author [see Abstract 2762 (1927)] there would be several groups of nematic elements, each group in parallel orientation, but the groups in random arrangement owing to Brownian movements, unless constrained by some external force. The thin layers (0·08 mm. thick) of liquid *p*-azoxyanisol appear quite transparent on the miscroscope stage, probably because their molecular orientation is that of the crystallites, parallel to the surface in the solid phase. But there is no orientation near the edges. Moll and Ornstein [Abstract 312 (1918)] observed that a magnetic field parallel to the surfaces clears the turbid liquid for some time, whilst a field at right angles clears it only momentarily as long as it is excited. If the layer be sufficiently thin, this boundary effect (random arrangement near the boundary) should predominate. The author supports this view by determining the dielectric constant, which is markedly diminished by a vertical magnetic field, but hardly altered by a parallel field. The measurements are made with a special condenser. The curve of the dielectric constant for increasing and decreasing fields is a loop, the value being lower for the descending branch. That would indicate a better orientation on decreasing the field intensity; the creation of the field has first to overcome the disturbing boundary effect (ascending branch), whilst there is no disturbance with decreasing field intensity as long, at any rate, as heat movements do not interfere. H. B.

2071. Atomic Spacing in Metals. V. M. Goldschmidt. *Zeits. f. phys. Chem.* 133. 5–6. *pp.* 397–419, *April*, 1928.

In any given crystal structure every atom is nearest to a definite number of other atoms. The author calls this number the coordination number [see Abstract 2820 (1927)]. The distances between the atomic centres and the coordination numbers are so related that the distances increase as the coordination numbers increase, while a diminution of the coordination from 12 to 8 would involve a decrease in the distance of about 3 %. This applies to typical ionic and atomic lattices and to metal crystals. Substances to be compared should be in comparable conditions. As regards the crystal structure of the elements the face-centred cube and the hexagonal crystal both represent closed packing, and are commensurate as to atomic distances. The coordination number for many elements and mixed crystals is 12; the number 8 (cæsium chloride) is also frequent in elements and mixed crystals. For these Debye-Scherrer measurements the author mixes the material with powdered rock-salt (lattice constant 5·628 Å.); he makes use of the data of Westgren and Phragmén [see Abstract 2178 (1925)] and of Barth and Lunde [see Abstract 32 (1927)], and effects transformation of one crystal form into another by adding a metal of higher valency (Zn, Al, Sn) to metals like Cu, Ag, Au [see Hume-Rothery, Abstract 1642 (1927)]. For mixed crystals M of atoms A and B, calculations of distances L_M, L_A, L_B are based upon $L_M^n = xL_A^n + (a - 1)L_B^n$, where x is the concentration of A, and n is unknown and differently estimated by various investigators. When A and B differ little as to atomic distances, however, the assumption of $n = 1$ or 3 makes little difference. Determinations of atomic radii (in the sense of W. L. Bragg) are made for the series Ru to Sb (ordinal numbers 44 to 51); Os to Bi (76 to 83); Mn to Ge (25 to 32). The transition 12 → 8 shows a contraction of 3·5 % for $Fe_\gamma \rightarrow Fe_\delta$, and of 3·3 % for (Cu + Pd) → CuPd; the transition 12 → 6 for SnSb a contraction of 4·12 %; the transition 12 → 4 for AlSb a contraction of 12·3 %, which indicates that the atomic radii in the zinc blendewurtzit structure and in diamond cannot be commensurable with the radii of metallic elements in the coordinations 12, 8, 6. On the other hand, the values agree fairly with the particle distances in ionic lattices. H. B.

2072. Investigation of the Behaviour of Real and Artificial Pearls in Ultra-Violet Radiation. J. A. A. Leroux and E. Raub. *Zeits. f. Phys.* 48. 9–10. *pp.* 722–728, 1928.

The paper employs the fluorescent properties of the real variety for the detection and selection of real pearls from those of the synthetic variety. Diagrams and photographs are given. The experimental work follows the usual lines. A mercury arc is concentrated on a pearl and the result recorded photographically. S. G. B.

2073. Quantising an Harmonic Oscillator in a Magnetic Field. T. Sexl. *Zeits. f. Phys.* 48. 9–10. *pp.* 611–613, 1928.

The author shows that the wave equation of the isotropic plane harmonic oscillator [see Fock, Abstract 1848 (1928)] can also be deduced on Schrödinger's perturbation theory. H. B.

2074. Parachor and Chemical Constitution, Part IX. Boron Compounds. J. J. Etridge and S. Sugden. *Chem. Soc., J. pp.* 989–992, *April*, 1928.

From the results of measurements of the surface tension and density of methyl and ethyl borates and from Mills and Robinson's data for boron trichloride [Chem. Soc., J. p. 1823, 1927], the values 15·4, 17·8, and 15·9 are obtained for the atomic parachor of boron. The mean value, 16·4, shows clearly that atomic parachors pass through a sharp minimum at carbon (4·8). It is noted incidentally that methyl alcohol and methyl borate form a mixture of maximum vapour pressure containing 30 % of the ester and boiling at 55°. [See also Abstracts 1162 and 1491 (1928).] T. H. P.

2075. Specific Heat of Carbon Dioxide. W. H. McCrea. *Cambridge Phil. Soc., Proc.* 24. *p.* 290, *April*, 1928.

A correction of a previous paper [see Abstract 263 (1928)], wherein the author suggested the possibility of a transition from one molecular form to another in CO_2. The specific heats calculated on this assumption for low temperatures gave a high and impossible maximum in the specific heat curve for higher temperatures. The effect of assuming a difference of potential energy between the two positions about which the system is considered to vibrate has been tried. The curve obtained for a value of this energy difference corresponding to a frequency ν_3, a fundamental frequency $2\nu_3$, and a moment of inertia $0{\cdot}5 \times 10^{-40}$ gm. cm.^{2}, agrees with observations for low temperatures, and almost coincides with C for high temperatures, but does not give a maximum in between. There still exists considerable discrepancy, however, and the writer again postulates a triangular form of molecule with anomalous behaviour at low temperatures. S. G. B.

2076. Fundamental State of the Helium Atom. E. A. Hylleraas. *Zeits. f. Phys.*, 48. 7–8. *pp.* 469–494, 1928.

The author's object was to calculate as accurately as possible the ionisation voltage of helium. To solve the Schrödinger wave equation for the two-electron problem a method was employed which corresponds exactly to that used by Ritz in solving variation problems. The calculations have been carried out to the eleventh approximation—that is to say, in calculating the characteristic value eleven characteristic functions are considered; the resulting value for the fundamental term differs from that determined experimentally by only 0·15 %, while for the ionisation voltage the difference is 0·48 %, the increase in the percentage being due to the fact that the energy of the helium atom has to be subtracted in this case. In an addendum to the paper attention is called to the possibility of improving the result, since the successive approximations converge more rapidly the better the first approximation is. The helium problem is attacked from another point of view, and though the calculations are carried out only to the fourth approximation, the calculated ionisation voltage is only 0·2 % below the experimental. The results of Kellner and Slater are noticed. H. N. A.

2077. Secular Changes in Electronic Orbits in a Magnetic Field. W. M. Hicks. *Phil. Mag.* 5. *pp.* 801–823, *May*, 1928. *Supplement.*

During the life even of an excited orbit there is time for secular effects to produce very large changes in the orbital constants, since an electron in an orbit of atomic dimensions makes about a billion circuits in 1/1000 sec. It is shown that there are two categories of variations; in I the line of apses continually regredes, the orbital planes swing up and down, with the maximum inclination when the apses coincide with the nodal line and the minimum when they are perpendicular; the nodal line constantly progredes. In II the line of apses oscillates about the line perpendicular to the nodal line; the orbital planes swing up and down, with their maximum and minimum inclinations both at instants when the apses are perpendicular to the nodal line. As in I the nodal line constantly progredes. Some numerical examples are worked out, and an estimate is made of the orders of magnitude of H, the magnetic field, and "a," the semi-major axis of the ellipse, below which the effect of H^3 and higher orders can be neglected. H. N. A.

2078. Spectra and Atoms. A. Fowler. *Chem. Soc., J. pp.* 764–780, *April*, 1928.

A summary is given of recent developments in the correlation of the structure of spectra with the structure of atoms, the principal points dealt with being: Bohr's theory, which interprets spectroscopic "terms" as energy levels of the atoms; Catalán's discovery of complex groups of related lines which involved terms of higher multiplicities and allowed of many spectra, not previously susceptible to analysis, to be built up, chiefly of complicated multiplets; the investigations by Russell and Saunders of groups of lines in the arc spectrum of calcium. The spectra of certain of the elements are surveyed in relation to the new table of atomic structures, the result being not only to indicate the systematic character of atom-building, but also to show that all the main features of the spectrum of an atom, however complex, may be predicted theoretically if the electron configurations are known, or that, conversely, from a knowledge of the spectroscopic terms the corresponding configurations of electrons can be correctly deduced. The great importance of the spectra of ionised atoms in supporting the general theory of atomic structures, in interpreting the spectra of the sun and stars, which give a great range of surface temperatures, and in showing that the spectral lines of gaseous nebulæ are due, not to the unknown element "nebulium," but to ionised oxygen and nitrogen, is pointed out. T. H. P.

2079. Notes on an Equation of Undulatory Mechanics. P. Humbert. *J. de Physique et le Radium*, 9. *pp.* 81–87, *March*, 1928.

A mathematical discussion is given of the general solution and certain particular solutions of the partial differential equation

$$\text{div grad } U = \frac{1}{c^2}\frac{\partial^2 U}{\partial t^2} + \frac{4\pi^2}{h^2} m_0^2 c^2 U,$$

which is important in wave mechanics as representing the propagation of the group associated with a moving particle of mass m_0. A particular solution given by L. de Broglie is shown to represent a group of waves travelling in different directions with frequencies in the immediate neighbourhood of a given frequency. W. S. S.

2080. Relativistic Cosmology. H. P. Robertson. *Phil. Mag.* 5. *pp.* 835–848, *May,* 1928. *Supplement.*

The general theory of relativity considers physical space-time as a four-dimensional manifold whose line-element coefficients, $g_{\mu\nu}$, satisfy the equations $G_{\mu\nu} = \lambda g_{\mu\nu}$ in regions free from matter and an electromagnetic field. The customary solution of these equations, in the form $ds^2 = -d\rho^2/(1-\kappa^2\rho^2) - \rho^2(d\theta^2 + \sin^2\theta d\phi^2) + (1-\kappa^2\rho^2)c^2d\tau^2$, suffers from presenting certain apparent paradoxes. In the present paper a mathematically equivalent solution which eliminates many of these paradoxes and which is susceptible of a possibly simpler interpretation is presented. [See also Abstract 853 (1916).] J. S. G. T.

METEOROLOGY AND GEOPHYSICS.

2081. Electrical Methods of Hygrometry. P. W. Burbidge and N. S. Alexander. *Phys. Soc., Proc.* 40. *pp.* 149–153; *Disc.,* 153–155, *April,* 1928.

An account is given of experiments performed to investigate the possibility of applying electrical methods to the measurement of humidity. Two methods are considered, depending on (1) the change in resistance of organic materials (cotton-wool and human hair) on exposure to water vapour; (2) the change in mobility of ions due to water vapour. Results show that in the first case the change in resistance with humidity is not linear, the logarithm of resistance being proportional to the humidity, while in the second the effect produced is too small to permit of accurate measurement. Thus in neither case does the method seem suitable for general use, though each could be applied in special cases. AUTHORS.

2082. World Weather. Part III. G. T. Walker and E. W. Bliss. *Roy. Meteorolog. Soc., Mem.* 2. 17. *pp.* 97–134, *April,* 1928.

The present paper forms a continuation of two papers in the *Indian Meteorological Memoirs,* Vol. 24, Parts 4 and 9, and extends the tables of relations between 20 centres of action to those between 32 centres. Of the new centres 9 deal with temperatures, 2 with pressures, 1 with Nile floods, 1 with ice in the Barents Sea, while 1 old centre is abolished. The relationships between the centres may be expressed most simply in terms of three systems, the Southern oscillation, the North Atlantic oscillation and the North Pacific oscillation. The nature of the relations with the oscillations are tabulated, the degree of closeness being shown numerically and the signs + or − used to indicate growth with an increase or decrease of the atmospheric circulation. Of the new centres the temperatures of Batavia and Samoa and the Nile floods are very important in the Southern oscillation, Samoa having in all in the four quarters 37 coefficients of 0·6 or over, Batavia temperature 78 " significant " coefficients during the year and the Nile 31 in one season. The oscillations are not regarded as controlled by sunspots numbers but as systematic swayings of interconnected world conditions which are slightly intensified or checked by solar conditions.

R. S. R.

2083. World Weather. G. Walker. *Roy. Meteorolog. Soc., J.* 54. *pp.* 79–87, *April*, 1928. *Nature*, 121. *pp.* 713–716, *May* 5, 1928.

The author refers to the large number of meteorologists who have investigated the connections between the weather in distant parts of the earth. Three large swayings or oscillations are considered: (1) the North Atlantic oscillation, (2) the North Pacific oscillation between the high-pressure belt and the winter depression near the Aleutian Islands, and (3) the Southern oscillation, mainly between the South Pacific and land areas round the Indian Ocean. Diagrams are given to illustrate these relations; 32 centres of action are now used and sunspot relationships added, and these yield 400 significant coefficients. The author shows how these relations have been used to predict the rice crop of Japan, rainfall at Java and Ceara, north-east Brazil, and the winter and spring temperatures of northern Europe. Finally, the prediction of Indian monsoon rainfall is considered and the results obtained with these predictions. R. S. R.

2084. Changes of Temperature with Height in the Stratosphere over the British Isles. L. H. G. Dines. *Roy. Meteorolog. Soc., Mem.* 2. 18. *pp.* 137–151, *April*, 1928.

Individual ascents do not support the view that in the stratosphere temperature is constant at all heights. The author sought to find whether the departures were associated with other variables in the atmosphere; 350 soundings extending from 1909–1925 were employed, most of these being over England, but a few over Scotland and Ireland. Using only those rising 2 km. or more above the tropopause an inversion averaging 3° C. was found at the tropopause; it did rise even to 10° C., while on 13 % of occasions it was zero. These zero inversions were more frequent in winter than in summer, and mostly occurred in a westerly air current. No correlation was found between the inversion and the lapse rate below it. It was found, however, greater by day than by night, in summer than in winter, and with a high rather than a low barometer. Allowing for isolation errors, which are more pronounced during ascent than during descent, the preliminary inversion is 2·7° C. in the first 2 km. of the stratosphere, the next km. is isothermal, and then a steady fall of temperature occurs of 0·5° C./km. Such evidence as is available is against the existence of a diurnal variation of temperature in the stratosphere.

R. S. R.

2085. Lunar Atmospheric Tide at Helwan, Madras and Mexico. S. Chapman and M. Hardman. *Roy. Meteorolog. Soc., Mem.* 2. 19. *pp.* 153–160, *April*, 1928.

The paper forms a continuation of a series of papers dealing with the lunar atmospheric tide [see Abstract 1710 (1924)]. The hourly barometric observations used were obtained at Abbasia in 1900–1904 and at Helwan in 1904–1908 for the Helwan calculation, at Madras 1841–1861, and Mexico 1902–1919. The seasonal and annual mean lunar inequalities were formed for groups of days centred at apogee and perigee and for intervening groups of days. The seasons used were the northern summer and winter and the equinoxes. Reductions were made as in former papers and the solar diurnal variation removed. A marked annual variation in the lunar atmospheric tide has been found at all stations investigated. The mean lunar diurnal inequality suggests an almost purely semi-diurnal variation. The results made it probable that the rise and fall of the oceans beneath the atmosphere (and also the tides in the solid body of the earth) play a distinct part in the production of the lunar atmospheric tide, but its distribution is much less regular than that of the solar semi-diurnal oscillation of the atmosphere. In a later paper, when further determinations are available, the irregularities of the lunar tide and its seasonal variation are to be examined in detail. R. S. R.

2086. Observation of Clouds with Special Reference to the Safety of Aviation. H. Hergesell. *Roy. Meteorolog. Soc., J.* 54. *pp.* 128–132, *April*, 1928.

The author gives particulars of methods employed at Lindenberg to determine the height and thickness of cloud layers. With wind velocities up to 3–4 metres per sec. spherical balloons are used to lift the registering apparatus; with velocities 4–7 metres per sec. a kite balloon is used, and thence up to 25 metres per sec. a captive balloon is employed. Ascents are made twice daily, the variation of temperature and relative humidity being obtained from the registrations. The single hair hygrometer used indicates more readily the upper limit of the cloud layers because of the temperature inversions and relative dryness. In regions of supercooled drops ice is condensed and the apparatus fails. Aeroplane ascents up to 6000 metres are made twice daily to get similar observations. The reports regarding cloud heights and thickness are distributed regularly by W/T by Lindenberg to all parts of Germany. Several plates show types of wave motion observed in cloud layers whose heights were found by means of a range finder. R. S. R.

2087. Measurements of the Ozone in the Upper Atmosphere in 1927. H. Buisson. *Comptes Rendus*, 186. *pp.* 1229–1230, *April* 30, 1928.

The author tabulates the results of daily measurements of the equivalent thickness of ozone measured during 1927 at Marseilles. The method employed was that devised by Fabry and Buisson [see Abstract 76 (1922)]. A series of photographs on the same day for different solar altitudes provides the absorption for different wave-lengths. On each plate the results for fourteen successive days at the same altitude are shown, and thus indicate the daily variation. The results confirm those of Dobson and Harrison [see Abstract 1532 (1926)] and of Götz. The annual variation is large, with a maximum in spring and a minimum in autumn, while short-period disturbances are ascribed to atmospheric changes of pressure. The results agree especially with those found at Arosa (Switzerland).

R. S. R.

2088. Commission for the Exploration of the Upper Air. *Meteorolog. Office, Air Ministry, M.O.* 300. [99 *pp.*], 1928.

Report of the meeting in Leipzig, August 29 to September 3, 1927.

2089. Distribution over the British Isles of the Average Number of Days with Rain during each Month of the Year. J. Glasspoole. *Roy. Meteorolog. Soc., J.* 54. *pp.* 89–101; *Disc.*, 102–104, *April*, 1928.

2090. Propagation of Leading and Trailing Parts of a Train of Elastic Waves. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 4. *pp.* 107–122, *March*, 1928. *In English.*

The propagation of finite groups of waves of the Rayleigh type, taking into account the possibility of dispersion and the effects of viscosity, is examined mathematically. No change of type occurs in a perfectly elastic body. Waves having a group velocity in a dispersive medium travel with this velocity, keeping the original extent of the disturbance. However sharp the original form may be, there is flattening with viscosity present. The law of "pull and push" in seismology does not hold in a dispersive medium. W. G. B.

2091. Reflection of Elastic Waves Generated from an Internal Point in a Sphere. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 4. *pp.* 123–130, *March*, 1928. *In English.*

The nature of the reflection is the same as that at a plane boundary, and the expression of the surface displacement is simple if the wavelength is small compared with the radius. In the case of the reflection of purely distortional waves, the maximum surface displacement is situated at some latitudinal distance which varies with the depth of the origin.

W. G. B.

2092. Forerunners of Earthquake—Motions of Certain Earthquakes. T. Matuzawa, K. Hasegawa and S. Haeno. *Tokyo Univ. Earthquake Research Inst., Bull.* 4. *pp.* 85–106, *March*, 1928. *In English.*

The authors consider that the mode of development of earthquake motions depends on the locality where the earthquakes originate and that the mechanism occurrence in any given locality may vary and so give different indications of certain phases of motion. A detailed study has been made of the seismic waves produced by a number of earthquakes in the neighbourhood of Tokyo, and these show the same characteristics of the three phases to a greater or less extent, but those from the neighbouring ocean do not. The time and distance relation for each phase is examined and the PS difference taken as a measure of the distance of origin of the earthquakes. For the Kwanto district the authors consider that the P phase is transformed into two parts, the P and S, in the upper layer, while the S phase is similarly transformed, except when the plane of vibration is parallel to the plane of the discontinuity. Theoretical considerations regarding the time-distance relation lead to most earthquakes in this district being located at a depth approximating to 50 km. The authors state that the consideration of the trajectory of the waves gives better results than that of the angle of their emergence. R. S. R.

ASTROPHYSICS.

2093. Particles of High Velocity in the Chromosphere. R. W. Gurney. *Roy. Astron. Soc., M.N.* 88. *pp.* 377–379, *March*, 1928.

When a helium atom returns to its lowest quantum state, or calcium becomes doubly ionised, or hydrogen or sodium ionised, in each case the atom will fall under gravity until reversed by collisions with other atoms, thus Ca^{++} ions are, in the extreme low density of the upper chromosphere [see Abstract 1034 (1925)], continually removed by gravity as soon as formed, and the neutralisation of these ions in the lower layers will produce a "sink" of electrons there. Instead of a static balancing of gravity against radiation-pressure there is a slow upward movement to compensate the falling of atoms in ionised unsupported states. The lower chromosphere is subjected to a continual rain of falling atoms, and their impacts may be either elastic or inelastic resulting in the excitation of the atom. Hydrogen and helium atoms colliding with heavy atoms may be reversed; if colliding with calcium ions may receive a velocity double that of the latter. Inelastic collisions may perhaps cause excitation by the conversion of the kinetic energy of colliding atoms, and in the more violent impacts there may be a mechanism for the production of excited and ionised helium more efficient than by absorption of radiation. [See also Abstract 1726 (1924).]

A. S. D. M.

2094. Integral Equation of Radiative Equilibrium. U. Wegner. *Zeits. f. Phys.* 48. 9–10. *pp.* 748–750, 1928.

A mathematical criticism of the integration for radiation equilibrium given by Ambarzumian and Kosirev [see Abstract 1531 (1928)]. A. D.

2095. Personal Equations in the Measurement of Double Stars. S. de Glasenapp. *Comptes Rendus*, 186. *pp.* 681–683, *March* 12, 1928.

The extent of the micrometric errors in the measurements of double stars has been largely carried out by making use of artificial star images. There are objections to this method, and a scheme is described which makes use of a series of selected stars. A. Wh.

2096. Personal Errors in the Observations of Double Stars. P. Salet. *Comptes Rendus*, 186. *pp.* 941–942, *April* 2, 1928.

In a recent paper [see preceding Abstract] de Glasenapp states that the use of reversing prisms, as used to eliminate the personal errors, introduces a diminution of intensity. It is pointed out that this diminution is only of the order of 10 %. A. Wh.

2097. Rotation of the Galaxy. J. S. Plaskett. *Roy. Astron. Soc.*, *M.N.* 88. *pp.* 395–403, *March*, 1928.

The author describes Lindblad's theory [see Abstract 2688 (1927)] but uses the simple method of Oort, obtaining $A = V(1 - R\delta K/K\delta R)/4R$, where A is the residual radial component in kilometres per second, due to galactic rotation, for stars at a distance of one parsec; R is the sun's distance from the centre of the galactic system; K is the gravitational force due to the whole system, and is obviously directed to the centre; V is the circular velocity of rotation at the sun, and equals $\sqrt{RK}$. The general equation for stars in all latitudes is $\rho = V_0 \cos\lambda + rA \sin 2(l - l_0) \cos^2 b$, where r denotes the distance of the star or star group from the sun, l is the galactic longitude, and l_0 the galactic longitude of the centre of the system; ρ is the radial velocity of star, b is its galactic latitude, V_0 is the velocity of the sun towards and λ the distance from the solar apex of the stars considered. The stars used were 509 of types 0 to B5, divided into six groups of bright and faint B0–B2, B3–B5 and 0 stars spread through eight divisions of galactic longitude. The value found for $l_0 = 324^\circ\cdot5 \pm 1^\circ\cdot8$ is in almost exact agreement with 325° for the centre of the globular cluster system and with Oort's value, 342° ± 2. Schilt's value of 340° from proper motions is of lower weight [see Abstract 302 (1928)]. He concludes definitely that the radial velocities confirm Lindblad's hypothesis of a common centre of rotation for the galactic subsystems. K is certainly *not* constant in value, seeming to be much larger for the hottest and brightest stars. The rotation term, $\bar{r}A$, is always positive, and for the hotter stars increases markedly and nearly in the ratio of faintness (or increasing distance). The mean value of $A = +0\cdot0155 \pm 0\cdot0007$ km. per sec. per parsec. A. S. D. M.

LIGHT.

2098. Comparison of the Absorption of Water and Quartz in the Extreme Ultra-Violet. K. Tsukamoto. *Rev. d'Optique*, 7. *pp*. 89–108, *March*, 1928.

The determinations were made by the method of photographic photometry. A series of photographs, using constant exposure, were obtained on one plate using a source of constant intensity and weakened in successively known proportions. The effects produced by the water and quartz were compared with these standard spectra and their absorption coefficients then compared. To obtain a source of constant intensity in the desired region 1830–2300 Å. a condensed spark discharge between metallic electrodes was used and a metallic grating used to reduce the intensity of the illumination. For water and quartz the absorption found for various wave-lengths between 2200 and 1829 Å. is tabulated. For water the values are smaller than those found by Kreusler, while for quartz the values exceed Pfluger's. The wave-length-absorption curves for these two substances intersect for $\lambda = 1900$ Å. Water is very transparent for $\lambda > 1950$ Å., but below this value it decreases rapidly. The absorption of quartz increases slowly from 1830 to 2300 Å. R. S. R.

2099. Light Absorption in Opal Glass. G. Gehlhoff and M. Thomas. *Zeits. f. tech. Phys.* 9. 5. *pp*. 172–175, 1928.

Describes an investigation of the seat of the light absorption in opal glass. It has been thought that this takes place in the medium (clear glass) in which the diffusing particles are suspended. By preliminary experiments the authors find that for a particular type of glass the path of the light is about 3·9 times the actual thickness of the glass. With a glass of low iron content, the absorption in a plate of clear glass four times as thick as a plate of opal glas of similar composition was, however, only 3·8 % as compared with 14–15 % for the opal glass. It is concluded, therefore, that the absorption takes place chiefly in the suspended particles and not in the clear portion of the glass. J. W. T. W.

2100. Sensitiveness of the Eye. G. I. Pokrowski. *Phys. Zeits.* 29. *pp*. 269–271, *May*, 1928.

The curve of sensitiveness of the *fovea centralis* of the eye differs considerably from the energy-distribution curve of full sunlight, but it agrees remarkably with the energy-distribution curve of light reflected from foliage and also, less well, with the energy-distribution curve of firefly-light. The former seems to throw light on the environment in which the eye must have been developed. A. D.

2101. Constructing the Caustic Curve formed by Refraction at a Plane Surface. C. J. Smith. *Phys. Soc., Proc.* 40. *pp*. 156–157; *Disc.*, 157, *April*, 1928.

The paper describes a convenient method of constructing the caustic curve in question. The method depends on the properties of an ellipse which cuts the rays orthogonally. AUTHOR.

2102. Double Refraction. G. Todesco. *Accad. Lincei, Atti,* 7. *pp.* 394–399, *March* 4, 1928.

A method for the observation of very small double-refraction effects (accidental, electric, magnetic), based upon the use of a photoelectric cell to receive light from two crossed prisms. The current from the photoelectric cell is amplified by a thermionic valve of particular construction. The working is very sensitive and uniform. A. D.

2103. Birefringence and Dichroism of Thin Layers of Iron Obtained by Distillation. M. Cau. *Comptes Rendus,* 186. *pp.* 1293–1295, *May* 7, 1928.

Thin layers of iron are obtained on glass plates placed 1–2 cm. below an iron wire heated electrically nearly to its melting point. The apparatus is enclosed in an evacuated glass vessel. The films are of grey transparency, have a good polish, are durable and readily removed. When rectilinear polarised monochromatic light is passed normally through the film, rotation (R) and elliptical polarisation (ellipticity E) result. These quantities R and E were measured for different azimuths with layers of various thicknesses, and the relations found for R, E and A are set out. Birefringence alone would give only negligible rotation, while pure dichroism would not give ellipticity. The effects are localised in the metallic layer, are produced by the magnetic field of the current causing distillation of the wire, and disappear when the film is removed from the glass. The atoms become orientated and retain this after deposition. The orientation is stable and is not disturbed by an intense magnetic field parallel to the layers. Further tests are in progress. R. S. R.

2104. Curious Optical Theorem and its Geometrical Basis. A. A. Robb. *Phil. Mag.* 5. *pp.* 1114–1125, *May,* 1928.

The author deals with the problem of a series of particles starting out in various directions from a given point with uniform velocities and imagines a flash of light proceeding from one particle to each of the others in turn and finally back to the first. He proves on the basis of his own theory of time and space that the total time expended is the same as if the light-flash proceeded in the reverse direction. A mode of procedure is indicated also for the case where the particles travel along parallel paths. R. S. R.

2105. Internal-Focussing Anallatic Tacheometer. *Engineering,* 125. *pp.* 350–351, *March* 23, 1928.

The optical system consists of a 6-in. convex achromatic object glass of 1·5 in. aperture and a similar but concave focussing lens. The anallatic error is about 0·6 in. for a staff distance of 12 ft. The telescope is only 7·5 in. long. The horizontal circle is totally enclosed and the gaps at the verniers are covered with optically worked glass. The conical centres of the instrument are finished by scraping to a fit and not by grinding. This procedure gives a more lasting and a better fit. [See also Abstract 850 (1927).] A. A. D.

2106. Simple Spectrocomparator. F. Stanley. *J.O.S.A. and R.S.I.* 16. *pp.* 208–210, *March,* 1928.

The instrument is useful in distinguishing between lines which are relatively close (difference of the order of 1 Å.U.) and is useful in spectrum analysis. An iron spectrum is always taken as a comparison with the spectrum under examination. By means of a system of prisms this photograph can be viewed simultaneously with a specially prepared photograph of the iron arc with wave-lengths marked on. The optical system is arranged to give such a magnification to both fields of the instrument that both the standard iron spectrum on one side and the iron comparison appear of the same size. Unknown wave-lengths can then be found accurately. A. A. D.

2107. Ramsden Reflex Micrograph. J. V. Ramsden. *Journ. Sci. Instruments,* 5. *pp.* 135–137, *April,* 1928.

This micrograph is essentially an inverted microscope system, comprising the usual objective and ocular, from which the rays pass to a mirror and are reflected forward and upwards on to a screen where they may be either visually examined, or a photographic plate may be substituted for the frosted screen and the image recorded by photography. AUTHOR.

2108. Optical Multipliers. S. J. Turlyghin. *Zeits. f. Instrumentenk,* 48. *pp.* 187–191, *April,* 1928.

Discusses various methods—repeated reflection, repeated refraction, reflection from a cylindrical mirror—for multiplying the deflection of a ray reflected from a Poggendorff deflected mirror. A. D.

2109. Performance of Projection Apparatus. A. Dargenton. *Rev. d'Optique,* 7. *pp.* 109–122, *March,* 1928.

The performance of a revolving projector, such as a lighthouse light, may be measured by the product of the intensity in the horizontal direction and the time of duration of the flash. Thus, if I_θ be the luminous intensity at any angle θ, the performance, from the optical point of view, is measured by $\int I_\theta d\theta$. The problem of the designer is to determine the focal length and curvature giving the greatest value of this quantity with a projection apparatus of specified aperture or area. The problem was solved by Fresnel for the parabolic mirror, and the author gives a general method by means of which it can be solved for all forms of projection apparatus. He applies this method (*a*) to the case of a dioptric system of annular elements illuminated by a plane disc source of light, and (*b*) to a cylindrical lenticular system illuminated by a cylindrical source. For the latter system he finds that for a lens of specified area the best performance is obtained when the total height is equal to the diameter. J. W. T. W.

2110. Influence of Pressure on Photophoresis. J. Mattauch. *Ann. d. Physik,* 85. 7. *pp.* 967–980, *May* 2, 1928.

Ehrenhaft [see Abstract 1085 (1918)] has stated that the motion of illuminated particles (photophoresis) is independent of pressure; theoretically, however, pressure must have an effect. The present author has made an attempt to correlate experimental results with theory, using selenium as the experimental substance—its light negative particles being still large enough for readings to be obtained at low pressures. It is shown that below an air pressure of 300 mm. of mercury there is a definite connection between pressure and the photophoretic force, both for light positive and negative particles. Above this pressure there is no real connection, thus accounting for Ehrenhaft's statement. The measurements of photophoresis on the same particles at different pressures are comparable with radiometer measurements, whilst the radiometer action of photophoresis shows the same pressure connection and regularities that Westphal found for macroscopic flat and cylindrical radiometers. Also Hettner's interpolation formula [see Abstract 2071 (1926)], for the range in which the mean free path of the gas and the radii of the particles are of the same order, is in agreement with the experimental results. Experiments were also carried out in different gases, but without much success. R. C. F.

2111. Thermal Variation of Magnetic Rotatory Power in a Case where the Coefficient of Magnetisation is Positive and Independent of the Temperature. H. Ollivier. *Comptes Rendus*, 186. *pp.* 1001–1003, *April* 11, 1928.

The compound studied was potassium dichromate, which is feebly paramagnetic and shows a variation of less than 1 % between 12° C. and 66° C. The magnetic rotatory power per gramme of the salt, deduced by means of an additive law from values observed in a strong aqueous solution, was found to be the same at 7°, 13·9° and 61°. T. M. L.

2112. Optical Method of Measuring Small Vibrations. H. A. Thomas and G. W. Warren. *Phil. Mag.* 5. *pp.* 1125–1130, *May*, 1928.

An interferometer method of measuring small mechanical vibrations, such as those encountered in telephone diaphragms and structures, is described, and its application to the measurement of the vibration of a stiff reed is considered. The essential principle of operation of the interferometer is that in which one plate is attached to the vibrating system and the other plate is fixed. A standard cone loud-speaker movement was examined at various audio frequencies and amplitudes, and curves illustrate the relation found between the movement and the current at various frequencies. Approximately the amplitude is proportional to the current. A further curve illustrates the resonance of the reed at a frequency of 1060. The shape of the response characteristic with constant input current is compared with the theory of a vibrating reed with fixed supports at both ends, and good agreement with experiment is obtained. The method can be adapted readily for the study of the vibration of light moving systems. R. S. R.

2113. Image Destruction by Desensitisers. Lüppo-Cramer. *Z. f. wiss. Phot.* 25. *pp.* 282–287, *May*, 1928.

Describes the results of experiments carried out on plates exposed to light through a red filter, both before and after desensitisation. The desensitisers used on various types of plates were phenosafranin, pinakryptolgreen and pinakryptolyellow. From results obtained it is concluded that there is a close connection between the Herschel effect and the effect of picture destruction by red light in the presence of desensitising dyes. With desensitisers, the fading effect must still be considered, although this is not so pronounced after desensitising as before. The sensitiveness of the plates to red light is, however, often increased by desensitising. R. C. F.

2114. Colour Temperature of Burning Magnesium. W. Dziobek. *Z. f. wiss. Phot.* 25. *pp.* 287–290, *May*, 1928.

Eder [see Abstract 80 (1928)] has shown that the value of 2400°

absolute, which is usually given for the colour temperature of burning magnesium, cannot be correct. The present author describes a method of obtaining this colour temperature by colour-matching the light from burning magnesium against the light from a gasfilled lamp, transmitted by a blue filter. Using the transmission curve of the blue filter together with the colour temperature of the gasfilled lamp, when burning at the colour-match voltage obtained from the above experiment, the colour temperature for burning magnesium is found to be 3700° K. R. C. F.

2115. Colour-Screen Plate Technique. E. A. Bierman. *Phot. J.* 68. *pp.* 197–200; *Disc.*, 200, *May*, 1928.

Briefly describes the technique of colour-screen plate working for autochrome plates, as developed by the author. R. C. F.

2116. New Effect of Chromic Acid on Photographic Plates. E. P. Wightman and S. E. Sheppard. *Kodak Research Lab. Comm. No.* 339. *Phot. J.* 68. *pp.* 201–205, *May*, 1928.

Describes the effect of a fairly dilute solution of chromic sulphuric acid on two experimental emulsions made with "inert" gelatine. It was found that such treatment resulted in an increase in sensitivity for both emulsions. Differences in detail in these emulsions gave rise to different results for the gammas of the emulsions, and also for the effect of the time of treatment with chromic acid. In one case no changes in γ or in sensitivity due to differing times of treatment were observed, but washing with water to remove the soluble bromide before treatment gave an additional increase in sensitivity. For the other emulsion, both a change in γ and a varying effect for increasing times of treatment were observed. With normal emulsions and with an emulsion made with another desensitised gelatine, desensitising only occurred upon treatment with chromic-sulphuric acid. No satisfactory explanation is given for this phenomenon, although three possible hypotheses are mentioned.

R. C. F.

2117. Recording Photoelectric Photometer. C. Müller. *Zeits. f. tech. Phys.* 9. 4. *pp.* 154–157, 1928.

Describes a method by which it is possible to make allowance for the disturbances and slow changes in sensitivity which normally introduce uncertainties into the measurements made with a recording photometer. The method consists, essentially, in recording alternately the light to be measured and the light from a standard lamp. The records obtained from the latter give a basis for reducing the measurements on the unknown lamp to a constant proportionality factor. In order to obtain records at various intensities from a single stationary standard lamp a sector disc of special construction is inserted between this lamp and the photoelectric cell. This disc is "stepped" so that by moving it from one position to another transmission factors of 80, 60, 40 and 20 % are obtained. Examples of the application of the method are given, including a description of the determination of the polar curve of light distribution from a lamp. J. W. T. W.

2118. Brightness of Tungsten Spirals. G. Holst, E. Lax, E. Oosterhuis and M. Pirani. *Zeits. f. tech. Phys.* 9. 5. *pp.* 186–194, 1928.

The three dimensions characterising a spiral filament are *d*, the filament diameter, *Kf*, the bore-factor ($Kf \times d$ = internal diameter of spiral), and S*tgf*, the pitch factor ($Stgf \times d$ = pitch). The authors first describe apparatus for producing drawings of the projection of a spiral of any given characteristics when viewed at any specified angle with the axis of the spiral. From such drawings it is possible to construct, for any given spiral, polar curves showing the area of inner surface and of total surface visible at each angle. Specimens of these curves are given in the paper. By means of a photograph and microphotometric measurements of blackening it is possible from the results so obtained to calculate the luminous flux given by a spiral of specified characteristics. This has been done and the results show satisfactory agreement with direct measurement. The brightness of the interior is greater than that of the exterior of the spiral in a ratio varying from 1·5 to 2 as S*tgf* varies from 2·96 to 1·35. J. W. T. W.

2119. Dimming and Extinction (Tilgung) of Phosphors by Light of Different Wave-Lengths. H. Moser. *Ann. d. Physik,* 85. 6. *pp.* 687–710, *April* 17, 1928.

Experiments carried on with selenide oxide and sulphide phosphors. With oxides the dimming [see Lenard, Abstract 810 (1910)] is most prominent, with selenides extinction, while with sulphides both are present in equal degree. In the latter the dimming is greater than with oxide phosphors, and with selenides the extinction effect is greater than with sulphides. These effects are in accord with Lenard's hypothesis on the effects. The quantitative observations on total weakening (dimming and extinction) show an increase from O → S → Se and from Ca → Sr → Ba. There is a parallelism between the weakening effect of light and of electric fields. Spectral observations show no shift of the *x* maximum, but a shift of the *y* maximum towards the red from O → S → Se. This is taken to mean that *x* corresponds to the characteristic vibration of the metal atom and *y* to the negative binding atom. J. E.

2120. Sulphide Phosphores, Antimony and Magnesium Alkaline Earths. Ilsemarie Schaper. *Ann. d. Physik,* 85. 7. *pp.* 913–952, *May* 2, 1928.

The phosphores arc prepared after Lenard and Klatt, in the case of the Sb-phosphores, which resemble the Bi-phosphores, by heating the ground mass (alkaline-earths sulphides) sometimes with rather large proportions (up to 10 %) of antimony (as tartar emetic), with or without addition of alkali salts, to different temperatures for various periods in order to bring out the bands of different characters: α observed with additions; β observed especially at either very high or low temperatures; γ excited by radiations of different wave-lengths; and δ studied by their rate of intensity changes. The separation of α and δ bands was facilitated by the use of light filters. All the phosphores showed at ordinary temperature a momentary excitation of α (and δ) bands in the ultra-violet, traced down to 200 $\mu\mu$. Nearly all the α and δ bands were excited by the wave-lengths 358 and 283 $\mu\mu$. Phosphores prepared by long heating to high temperatures, especially when free of additions, showed surprisingly low dielectric constants, measured with the aid of a special condenser [see F. Schmidt, Abstract 2894 (1927)]. This was not due to the presence of oxygen, but was connected with low density and little sintering. Oxide phosphores CaO Sb were also prepared. All the Sb-phosphores showed their β-bands when heated in the flame, the CaS Sb (these symbols merely indicate the chief constituents) in the blue at once, SrS Sb during the cooling. Of the Mg-phosphores, MgSMn has a deep red phosphorescence near 665 $\mu\mu$ which persists at temperatures down to − 50° C. As the very small concentration of Mn decreases, the upper temperature limit of this emission rises from 62° to 78°. The most intense emission of long duration was observed in MgS Sb. H. B.

2121. Measurement of the Energy of a Spectral Line Excited by Electronic Impact. P. Bricout. *J. de Physique et le Radium*, 9. *pp.* 88–110, *March*, 1928.

An experimental arrangement is described for determining the relative intensities of a given spectral line emitted by mercury vapour at constant pressure, when excited by means of an electron pencil of constant intensity and of varying known velocities. A special feature of the arrangement is the device for suppressing the filament current of the electron source (a carbon filament) during the periods in which the electron pencil is allowed to impinge on to the mercury vapour. The device is electromagnetic and does not involve any mechanical commutator breaking the filament circuit. The mercury resonance line λ2536 was investigated and the intensity found to attain a pronounced maximum for impinging electrons of velocity equivalent to a fall through 6·5 volts. A tentative theory of the observed variation is advanced based on semi-classical notions of atomic structure. An estimate is also made of the absolute amount of energy radiated in the line λ2536. It is estimated that for impinging electrons of velocity 6·5 equivalent volts forming a current of 60×10^{-6} amp./cm.^{2}, the number of quanta of λ2536 radiation emitted by saturated mercury vapour at 17° C., per unit volume per second, equals $3 \cdot 0 \times 10^{12}$. Finally, the probability of emission of a quantum of this radiation in a collision between a neutral atom and an electron of velocity 6·5 equivalent volts is given as 0·97, although this number is claimed to represent only the order of magnitude of the result. W. S. S.

2122. Estimating the Intensities of Spectral Lines. W. H. J. Childs. *Phys. Soc., Proc.* 40. *pp.* 132–147; *Disc.*, 147–148, *April*, 1928.

A critical account of several methods of spectral photometry applied to the special case of the band spectrum of helium. With the method finally adopted, the line spectrum is photographed in the usual way, after which the plate has to be calibrated. To do this the slit of the spectroscope is illuminated in a special manner by a tungsten filament lamp, so that upon development the plate exhibits a number of images of continuous spectra of progressively increasing density. From these images may be ascertained (*a*) the relation between intensity of light and density of image, and (*b*) the relation between plate sensitivity and wave-length of the incident light. Density measurements are obtained by a simply constructed selenium cell microphotometer, with which the density contour of each line can be investigated if necessary. Both visual and thermopile microphotometers are also described, and a list of papers dealing with the subject is given. AUTHOR.

2123. Shape and Intensities of Infra-Red Absorption Lines. D. M. Dennison. *Phys. Rev.* 31. *pp.* 503–519, *April*, 1928.

An expression for the shape of an infra-red absorption line is developed on the basis that the principal factor in the broadening of a line is the limitation of the length of the wave train a molecule may absorb due to its perturbation by thermal collisions. The shape of the line is accordingly found by expanding the finite wave train with a Fourier integral and then integrating over the distribution of the lengths of wave train given by the kinetic theory of gases. The absorption coefficient as found in this way may be expressed to a high approximation by means of two damping curves involving the number of molecules per unit volume, the temperature, and σ, the effective diameter. To apply this result to the analysis of observed infra-red spectra allowance must be made for the low spectrometer resolution due largely to the wide slits employed. Two expressions are developed, holding for all but very weak lines, which relate the area under the absorption line Abs., the minimum value of the transmission $T_{\text{min.}}$ and the true intensity α with the slit width a, the cell length l, and the molecular constants: Abs. $= [5{\cdot}412\alpha n\sigma^2 l]^{1/2}/[\pi h m]^{1/4}$, Abs. $= -2{\cdot}42a \log_{10} T_{\text{min}}$. It is shown that these formulæ are capable of interpreting the absorption lines of the infra-red spectrum of HCl observed by R. F. Paton and yield a value of $10{\cdot}8 \times 10^{-8}$ cm. for σ. The meaning of σ, the distance to which two molecules may approach without altering each other's phases, as well as the range of validity of the assumptions is discussed and a correction to the absorption area formula for faint lines is deduced. In connection with a consideration of the absorption measurements of HCl by Kemble and Bourgin, a computation is made of the effective moving charge of the molecule giving the value $\epsilon = (0{\cdot}199)\ 4{\cdot}77 \times 10^{-10}$ e.s.u. AUTHOR.

2124. Molecular Spectra of Sulphur. B. Rosen. *Zeits. f. Phys.* 48. 7–8. *pp.* 545–556, 1928.

The assumption of Graham that the absorption of sulphur vapour in the long-wave region is due to S_8 molecules, and that in the region between the ultra-violet and the blue-violet to the molecules S_6 and S_4, is considered not to be in accordance with the author's views [see Abstract 2536 (1927)]. From a series of measurements on the absorption bands under very varied conditions it is found that the formula obtained by the author in his work on the short-wave region,

$$v = 32{,}140 + (424{\cdot}4n' - 2{\cdot}7n'^2) - (724{\cdot}5n - 2{\cdot}91n^2),$$

also holds for the long-wave spectra; and it is established that the spectrum which is separated in the blue-violet region at higher temperatures is identical with that which at lower temperatures forms in the same spectral region as the long-wave branch of the ultra-violet spectrum, and is therefore due to the S_2 molecule. The intensity relations of these band spectra are discussed. L. L. B.

2125. Swan Band Spectrum of Carbon. W. E. Pretty. *Phys. Soc., Proc.* 40. *pp.* 71–77; *Disc.*, 77–78, *April*, 1928.

The Swan spectrum has been obtained in carbon monoxide and in the carbon spark in the absence of hydrogen. A discussion of the results of experiment and theory leads to the conclusion that the emitter of the Swan band system is the molecule of carbon C_2. AUTHOR.

2126. Ultra-Violet Absorption Spectra of H_2CO and CO. V. Henri and S. A. Schou. *Comptes Rendus*, 186. *pp.* 1050–1052, *April* 16. 1928.

The absorption spectra of formic aldehyde and CO are very analogous;

the molecule of formic aldehyde is bivalent, having a system of triplets with the same separations as in the case of CO. Besides, in the absorption spectrum of CO we find the intercommunication bands ${}^1S - {}^3P$ as in the case of divalent atoms. A. D.

2127. Ultra-Violet Absorption Spectrum of Cod-Liver Oil. J. W. Woodrow. *Phil. Mag.* 5. *pp.* 944–946, *May,* 1928. *Supplement.*

It is shown that the characteristic ergosterol absorption bands can be observed in a thin film of cod-liver oil by means of a sensitive photoelectric spectrophotometer. AUTHOR.

2128. Applications of Duane's Quantum Theory of Diffraction. E. J. Williams. *Cambridge Phil. Soc., Proc.* 24. *pp.* 343–356, *April,* 1928.

Duane's quantum theory of diffraction is applied to the reflection of electrons by crystals and to the spatial distribution of photoelectrons and fluorescent radiation from a crystal. Two alternative criteria for coherence are given. According to the second of these there is coherence provided that the momentum imparted to the components of a system during the process concerned is insufficient, owing to quantum restrictions to their motion, to change their energy. On this supposition, in the scattering of radiation by a crystal there is complete coherence for the lower orders but not for the higher orders, the reflected intensity being reduced as the result of incoherent scattering. The specular reflection by gases is also considered. W. H. GE.

2129. Diffraction of X-Rays by Line Gratings. J. Thibaud. *Phys. Zeits.* 29. *pp.* 241–261, *May* 1, 1928.

This paper contains the chief results of the application by the author of the line-grating method of investigation to the intermediate X-ray ultra-violet region. A short theoretical treatment of the problem of diffraction at grazing incidence is first given, including investigation of the sharpness and dispersive power of the arrangement. The author then describes the phenomena of total reflection of X-rays and the apparatus he has used for the diffraction of X-rays of normal wave-length using the visual gratings (50–200 lines per mm.), and gives excellent spectra of the K series of Cu and Fe produced by this method. The absolute values of λ thus obtained are in complete agreement, within the limits of experimental error, with those obtained in crystal investigations. The paper then describes a vacuum spectrograph for use in the outer ultra-violet; fairly complete experimental detail is given and a description of the spark spectrum of Cu in this region (900–144 Å.). Practically the same arrangement may be used for X-rays of long wave-length (measurements being made up to 68 Å.) using a grating having 1180 lines/mm. Again beautiful spectra are reproduced in this region. The K lines of N, O, C and B are measured and the K and L energy levels of the lighter elements calculated. The production of a continuous X-ray spectrum is described and the absorption of these rays on the light elements, particularly C. The paper continues with a discussion of the differences between the values of the wave-lengths of very soft X-rays obtained by grating and crystal methods respectively, more particularly the K-series of Boron measured by Dauvillier. The divergence is explained in terms of the refraction of the rays in the crystal, the value of $\delta = 1 - \mu$ being $1{\cdot}13 \times 10^{-2}$ for the moleic acid crystal used by Dauvillier. The crystal results also show a marked diffuseness, whereas the line grating spectra are extremely sharp. This is explained in terms of the vibrations of the atoms of the crystal and it is shown that the observed widths are of the order to be expected theoretically. The paper concludes with suggestions as to the application of the line grating used tangentially to astrophysical and other problems, interesting though negative results using γ-rays and a stream of electrons being recorded. W. V. M.

2130. X-Ray Diffraction in Liquids. C. Drucker. *Phys. Zeits.* 29. *pp.* 273–281, *May* 1, 1928.

One of the *Zeitschrift* "Report" series, giving an historical and critical summary of published work on X-ray diffraction patterns of liquids up to the present year. [See also Abstracts 120, 371, 948 (1928).] Tables of experimental data (recalculated in some instances) are reproduced. A general account is given of the present state of the problem, and of the difficulties of obtaining diffraction patterns which can be unequivocally interpreted in terms of the molecular constitution of the liquids (effects of polymerisation, etc.). It is suggested that a new technique, involving the use of very soft X-rays, will have to be developed before definite information on molecular structure can be derived from the diffraction patterns. H. R. R.

2131. Electrified Spherical Particles, Photoelectric Effect and Fluorescence Spectrum of X-Rays. L. Décombe. *Comptes Rendus,* 186. *pp.* 1291–1293, *May* 7, 1928.

The production of the characteristic and the continuous spectra of X-rays can be noted while considering all monochromatic X-radiation of given frequency ν as due to collision between pulsating frequencies N_0 and N of two electrons (connected to pulsating spherical particles) of which one is brought to rest by collision and the other moves on with a smaller velocity. Then $\nu = N - N_0$, and $hN_0 = m_0c^2$, where h is Planck's constant, m_0 the mass of the electron at rest, and c the velocity of light. The X-ray photoelectric effect can be similarly analysed. The author considers the case of an atom receiving X-radiation of frequency ν (components N and N_0), and the frequency of the expelled electron is given by $N_1 = N_0/\sqrt{1 - \nu^2/c^2}$ and $N_1 > N_0 > N_0'$. Further, ν is given by de Broglie's formula, and it is shown that $\nu = N_1 - N_0'$. Thus the frequency of collision is given as the difference between the pulsating frequency N_1 of the photoelectrons expelled and the pulsating frequency N_0' of those of the same level not expelled. The escaping electrons have all frequencies between N_0' and N_1 and from resonance all X-radiations of the series W (fluorescent spectrum) with frequencies $\ngtr (N_0 - N_0')$. [See also Abstract 541 (1928).] R. S. R.

RADIOACTIVITY.

2132. Precision Methods in Radioactivity. L. Bastings. *Journ. Sci. Instruments,* 5. *pp.* 113–122, *April,* 1928.

The simplest type of insensitive gold-leaf electroscope, as used in radioactive work, is critically and experimentally investigated with a view to increasing the accuracy of measurements made with this instrument. Results are quoted showing a consistency of the order of 1 in 1000, and highly accurate comparisons are shown to be possible between radioactive sources of widely differing magnitudes. AUTHOR.

HEAT.

2133. Graphical Investigation of Heat Conductivity in Solid Bodies. F. Nussbaum. *Zeits. f. angew. Math. u. Mechanik,* 8. *pp.* 133–142, *April,* 1928.

This is a paper divided into eight sections in which an attempt is made, with certain simplifying assumptions, to study the conduction of heat in rods by means of diagrams. Seven of the eight sections deal with what the author calls a simple rod, *i.e.,* one in which the section, specific heat, and conductivity are constant. In the remaining section these quantities are variable with position along the rod. The paper includes complicated diagrams in illustration. T. B.

2134. Asymptotic Expansion for $\sum_{0}^{\infty}(2n+1)e^{-\sigma(n+\frac{1}{2})^2}$. H. P. Mulholland. Also Introductory Note on the Theory of Rotational Specific Heats. R. H. Fowler. *Cambridge Phil. Soc., Proc.* 24. *pp.* 280–289, *April,* 1928.

An entirely mathematical treatment of the subject, which does not lend itself to abstracting. S. G. B.

2135. True Specific Heat of Nickel by a Direct Electrical Method. (Mrs.) C. Lapp. *Comptes Rendus,* 186. *pp.* 1104–1106, *April* 23, 1928.

The specific heat of pure nickel was determined at temperatures from − 175° C. to + 460° C. The nickel, in the form of wire, was heated by a current for a given time, and the supplied energy was found from a wattmeter; temperatures were obtained from a thermocouple. The specific heat of nickel increased from 0·055 at − 175° to 0·1577 at 353° C.; thereafter there was a rapid drop to 0·1252 at 360·5° C., after which the specific heat increased slowly to 0·1288 at 460° C. The Curie point is 357·6° C. and the results are in accordance with Weiss's theory. [See also Abstract 158 (1927).] G. E. A.

2136. Heats of Solution and of Dilution from Extreme Dilution to Saturation. Part IV. Lithium Bromide. E. Lange and E. Schwartz. *Zeits. f. phys. Chem.* 133. 3–4. *pp.* 129–150, *April,* 1928.

The determinations were carried out at 25° in accordance with previous work [see Abstract 472 (1928)] for solutions of extreme dilution to that of a concentration value of C = 32·29 mol. LiBr/100 mol. H_2O. Details concerning the apparatus and experimental procedure are given in full, as, for example, the new glass capillary stoker introduced into the calorimeter is fully described as well as an apparatus for the preparation of salt pearls from the melt of the purified salt. From the measurements of the heat capacities of the solutions throughout the whole concentration range or from the specific heats calculated from these data the temperature coefficients of the heats of solution are given. The curves obtained are found to resemble well in a qualitative manner the corresponding curves for lithium chloride. J. K.

2137. Zero Point Conditions. W. Jazyna. *Zeits f. Phys.* 48. 9–10. *pp.* 735–736, 1928.

Reply to a criticism by Verschaffelt [see Abstract 2336 (1927)] on the author's paper, "The Consequences of the Unreality of the Absolute Zero Point" [see Abstract 1819 (1927)]. The author points out that the statement on page 211, line 15, of his paper is a printer's error and should read: "Q is a function of the temperature and also of the volume." This statement now makes the rest of the paper and the conclusions, etc., in order. S. G. B.

2138. Fundamental Pressure Coefficient of Helium. W. H. Keesom and (Miss) H. van der Horst. *K. Akad. Amsterdam, Proc.* 30. 9–10. *pp.* 970–979, 1927. *Comm. No.* 188*a from the Phys. Lab., Leiden.*

The pressure coefficient of helium has been measured successively with two different helium thermometers of 108 and 355 cm.^{3} respectively. Full experimental details are included in the paper. The respective general means are 0·00366124 and 0·00366119 from which, after certain additional corrections, the value 0·0036611 is adopted. Taking all the factors together the maximum uncertainty is estimated at 2×10^{-7}. This value corresponds to that deduced from the hydrogen-helium data of Onnes and Boudin and Onnes and Cath. H. H. Ho.

2139. Dielectric Constant of Liquid Helium. M. Wolfke and W. H. Keesom. *K. Akad. Amsterdam, Proc.* 31. *pp.* 81–89, 1928. *Comm. No.* 190*a from the Phys. Lab., Leiden.*

A method is described for very accurately measuring the changes of the dielectric constant of liquid helium with temperatures. Provisional measurements indicate a discontinuity. A. D.

2140. Two Liquid States of Helium. W. H. Keesom and M. Wolfke. *K. Akad. Amsterdam, Proc.* 31. *pp.* 90–94, 1928. *Comm. No.* 190*b from the Phys. Lab., Leiden.*

Following up the discontinuity referred to in their paper on the dielectric constant of liquid helium [see preceding Abstract] the authors found that at a pressure of about 38 mm. a very peculiar change occurs in liquid helium, which in any case takes place within a very small temperature-region. There appears to be two liquid states of helium, of which the one which is stable at lower temperatures has the smaller density, the greater heat of evaporation and the smaller surface tension, and absorbs 0·13 cal./gm. of heat on transformation into the other liquid state. The temperature of transformation is about 2°·5 K. Whether the state stable at higher temperatures is liquid-crystalline remains to be ascertained. A. D.

2141. Rectilinear Diameter of Ethylene. E. Mathias, C. A. Crommelin and H. G. Watts. *K. Akad. Amsterdam, Proc.* 30. 9–10. *pp.* 1054–1056, 1927. *Comm. No.* 189*a from the Phys. Lab., Leiden.*

The apparatus has been described before [see Abstract 43 (1926) and 686 (1918)]. The ethylene was prepared using ethyl-alcohol and sulphuric acid and was then repeatedly distilled at a low temperature. The observations (which are tabulated) cover the range from + 8° C. to − 145° C. The diameter is given by $y = 0\cdot22179 - 0\cdot00061277\theta$. The formula for the diameter gives + 9·5° C. for the critical temperature and 0·21597 for the critical density, while the critical coefficient $\frac{RT_k}{p_k v_k} = 3\cdot524$. A. A. D.

2142. Vapour Tensions of Liquid Ethylene. C. A. Crommelin and H. G. Watts. *K. Akad. Amsterdam, Proc.* 30. 9–10. *pp.* 1057–1058, 1927. *Comm. No.* 189*b from the Phys. Lab., Leiden.*

The apparatus and preparation of the ethylene are very briefly described. The results are tabulated over the range + 8° C. to − 69° C. [See also Abstract 1800 (1921).] A. A. D.

2143. Preliminary Isotherms of Ethylene. C. A. Crommelin and H. G. Watts. *K. Akad. Amsterdam, Proc.* 30. 9–10. *pp.* 1059–1061, 1927. *Comm. No.* 189*c from the Phys. Lab., Leiden.*

The observations are represented by the Kamerlingh Onnes empirical equation of state

$$pv_A = A_A + \frac{B_A}{V_A} + \frac{C_A}{V_A} \ldots$$

The observations are not numerous, being confined to a range of pressure from about 20 to 40 atmospheres and a range of temperature from − 1° C. to 20° C. Some earlier hitherto unpublished results of Onnes together with some observations of Amagat are also used in evaluating A_A, B_A and C_A in the above formula. The results agree with those of Amagat but differ completely from those of Masson and Dolley [see Abstract 1898 (1923)]. A. A. D.

2144. Relativistic Rule for the Equipartition of Energy. F. F. P. Bisacre. *Phil. Mag.* 4. *pp.* 949–954, *Nov.*, 1927.

Classical mechanics leads to an equipartition rule such that the energy in each degree of freedom in a gas equals ½RT. The mechanics of the special theory of relativity requires some modification of this, for it can no longer be admitted, as in the classical theory, that given a particle it is equally probable, *a priori*, that its velocity has any selected value however great. The new criterion of "equal probability" due to Cunningham states that "any two states of a self-contained system which can be transformed into one another by a Lorentz transformation, are to be regarded as equally probable." Using this principle, two possible modifications of the equipartition rule are obtained giving the energy $\bar{\epsilon}$ carried in each degree of freedom. The behaviour of $\bar{\epsilon}$ as T varies is shown in the two cases by the following expressions:—

$$\text{Case 1.} \begin{cases} \bar{\epsilon} \to \tfrac{2}{3}\text{RT as T} \to \infty \\ \bar{\epsilon} \to \tfrac{1}{2}\text{RT as T} \to 0 \end{cases}$$

$$\text{Case 2.} \begin{cases} \bar{\epsilon} \to \tfrac{1}{2}\text{RT as T} \to 0 \\ \bar{\epsilon} \to \text{RT as T} \to \infty\,. \end{cases}$$

W. S. S.

2145. Relativistic Rule for the Equipartition of Energy (Further Note). F. F. P. Bisacre. *Phil. Mag.* 5. *pp.* 639–640, *March*, 1928.

Reasons are now given for preferring of the two results given in the original note [see preceding Abstract], the one which takes $\tau\beta^5$ as the volume of the cell of "equal *a priori* probability," and which leads to $\bar{\epsilon} \to$ RT as T → ∞. The determining consideration is that the calculation should be based, fundamentally, on a momentum diagram, where all the coordinates can and do go to infinity in contrast to the velocity diagram. W. S. S.

2146. Extension of Dulong and Petit's Law to Gaseous Compounds and Mixtures. A. Press. *Phil. Mag.* 5. *pp.* 832–834, *May*, 1928. *Supplement.*

Makes use of formulæ derived in a previous paper [see Abstract 981 (1928)], and arrives at the following improved form of Dulong and Petit's formula: $2a = sM(\gamma - 1)$, where a is theoretically a constant, s is the specific heat at constant pressure and M the molecular weight. A table gives the values of γ, $\gamma - 1$, s, M and $2a$ for twenty-one different gases, vapours and mixtures; the largest value for $2a$ is $3 \cdot 0$ and only three of the substances have a value less than $2 \cdot 3$; an estimate for mercury vapour, however, gives $2a = 3 \cdot 6$, but the data used are only provisional. H. N. A.

2147. Pauli's Equivalence Prohibition. P. Jordan and E. Wigner. *Zeits. f. Phys.* 47. 9–10. *pp.* 631–651, 1928.

This is a continuation of work on the quantum mechanics of the degeneration of gases [see Abstract 1229 (1926)]. The authors attempt to describe a gas subject to the Pauli equivalence prohibition without going beyond a space of three dimensions. This is done by describing the gas by means of a quantised three-dimensional wave field in which the non-commutative multiplication property of the wave amplitude is simultaneously responsible for the existence of corpuscular gas atoms and for the validity of Pauli's equivalence prohibition. The details of the theory show a close analogy to the corresponding theory of Einstein's ideal and non-ideal gases as developed by Dirac, Klein, and Jordan. E. E. F. d'A.

2148. Molecular Velocities, States of Stimulation and Probability of Transition in a Degenerate Gas. E. Persico. *Accad. Lincei, Atti*, 7. *pp.* 235–237, *Feb.* 5, 1928.

Formulæ are here applied to the extreme cases of small degeneration and complete degeneration, and to find how Einstein's law for the probability of transition from one quantic state to another has to be modified. [See Abstract 1652 (1928).] A. D.

2149. Method for the Photographic Examination of Moving Flames. A. G. White. *Chem. Soc., J. pp.* 1159–1161, *May*, 1928.

When applied to the examination of flame movements in tubes 2·5 cm. in diameter, the method of photographing the flame directly on to a sensitised plate or film moving at a known speed at right angles to the direction of motion of the flame gives poor results with certain gas mixtures, even when the lens and the tube containing the mixtures are both of clear quartz. The same mixtures are found to give satisfactory records by the use of a method based on the fact that the progress of the flame causes an abrupt change in the optical properties of the medium through which it passes. Light passing through the seat of the disturbance is refracted, so that if a beam passes through the tube containing the gas mixture and falls on a photographic plate moving at right angles to the direction of motion of the flame, the progress of the latter is indicated on the plate by two lines of similar form, one light and the other dark. These lines are close together, and once the velocity of the plate is known, the angle between the lines on the plate and the direction of its motion gives an accurate measure of the velocity of the flame at any desired portion of the tube. Use is made of a 500-c.p. "pontolite" lamp with no lens between it and the gas tube, approximate parallelism of the light passing through the tube being ensured by keeping the lamp 2 cm. from the tube. Only the light traversing the central zone of the tube is utilised, as the portion of the latter opposite the camera is enclosed in a copper sleeve with two narrow longitudinal slits opposite to one another. One slit is divided into 5 cm. lengths by spacing bars to give a length scale on the plate. The time scale is furnished by an electromagnetic light interrupter controlled by a tuning fork and marking intervals of 0·01 second on the plate. The falling-plate camera used is provided with a long cylindrical lens which focusses the light passing through the slits in the tube into a narrow band. T. H. P.

2150. Vapour Equilibrium of Aqueous Glycerine Solutions. D. F. Stedman. *Faraday Soc., Trans.* 24. *pp.* 289–298, *May,* 1928.

The length of time occupied in the preliminary experiments prevented the carrying out of the original object of the investigation, namely a determination of the equilibrium composition of vapour and liquid at definite pressures and temperatures in the system glycerine-water. The apparatus designed to measure the compositions of vapour in equilibrium with aqueous solutions of glycerine is fully described. The values of the vapour compositions in equilibrium with glycerine solutions from 50° to 200° C. and from 760 mm. to 60 mm. pressure are tabulated. The vapour pressure figures of anyhdrous glycerine from 50° to 200° C. are also given. By means of the simplified Clapeyron-Clausius equation the latent heat of evaporation of anhydrous glycerine is calculated from 55° to 195° C. The accuracy claimed for vapour composition measurements is from 0·1 to 0·5 % of the glycerine content and for vapour pressures about 1 %. J. K.

2151. Entropy and Thermodynamic Potentials of Real Gases and Mixtures of Real Gases, and a Mass Action Law for Chemical Reaction between Real Gases. Part I. General Thermodynamic Relations. J. A. Beattie. *Phys. Rev.* 31. *pp.* 680–690, *April,* 1928.

Thermodynamic quantities for mixtures of real gases.—Using the two assumptions, that at infinitely low pressures the energies of real gases are additive and the equilibrium pressure is given by the product of the total pressure into the mol. fraction, there are deduced general thermodynamic equations for the energy, heat content, entropy, thermodynamic potentials of gas mixtures and the chemical potential of a gas in a mixture in terms of the independent variables p and T, and V and T.

Mass action law for real gases.—Two forms of the mass action law are deduced depending upon the choice of p and T, or V and T, as the independent variables. AUTHOR.

2152. Thermodynamics of Mixtures. V. Fischer. *Zeits. f. Phys.* 48. 9–10. *pp.* 706–715, 1928.

Deduction of an expression for the contraction of mixtures. Calculation of the heat of mixture, the contraction and the vapour pressure of a water-sulphuric acid mixture. The results obtained are compared with those of other observers in the form of tables, and the theoretical values obtained by the expressions deduced are in excellent agreement. With regard to vapour pressures the theoretical values as compared with the Knoblauch table values are given. The agreement at high values of concentration is good, but there is considerable discrepancy for the low values. The comparison is made over the range of temperature 0° C. to 90° C. S. G. B.

2153. High-Sensitivity Measuring Instruments for Heat Radiation. G. Hettner. *Zeits. f. Phys.* 47. 7–8. *pp.* 499–508, 1928.

The theory of radiometers developed by the author leads to the conclusion that their sensitivity can be greatly enhanced. The paper describes an instrument for high sensitivity developed on these lines. After a review of previous work on the subject the author gives full details of its construction, use and limits of error. S. G. B.

2154. Measurement of the Kinetic Heat Effect in Air, Hydrogen and Argon. K. Rücker. *Ann. d. Physik,* 85. 7. *pp.* 831–865, *May* 2, 1928.

The kinetic heat effect was first defined by Gaede and later Weber deduced a new method of calculation for it. The present work was undertaken to verify the Weber formula. In order to do this it is essential that the accuracy of measurement of the kinetic heat effect over the Gaede measurements should be increased by 10 %. A successful attempt is made by means of a specially constructed thermopile of copper-constantan elements giving results with a mean experimental error of 0·3 %. The measurements so obtained are used in combination with the theory of Weber for the determination of the accommodation coefficient of the gas at the surface of the thermoelements. It is shown that on the striking of a solid boundary by a gas molecule the exchange between the boundary temperature and the translation temperature of the gas is analogous to the exchange between the boundary temperature and the rotation temperature of the gas. The paper contains the fullest experimental details and diagrams. S. G. B.

2155. Temperature Field over a Stationary Evenly Heated Plate. W. Nusselt and W. Jürges. *V.D.I.* 72. *pp.* 597–603, *May* 5, 1928.

The temperature field in the air above the plate was measured by the aid of thermoelements and thence was deduced the distribution of heat across the surface. The temperature proved to be inversely proportional to the fourth root of the distance from the under edge of the plate towards the upper. The temperature field thus measured was compared with results obtained by calculation from the improved Lorentz theory. From the results so obtained a further deduction was made to determine the path of the air currents over the plate. S. G. B.

SOUND.

2156. Investigations on the Monotelephone. R. Bauder and E. Ebinger. *Zeits. f. tech. Phys.* 9. 2. *pp.* 65–69, 1928.

To obtain pure reproduction, a flat membrane clamped at three points is used, tuned to about 540 periods per second; the overtones are considerably damped, and only feebly audible, while the sensitivity to the fundamental frequency is of the order of three times that of an ordinary receiver. A further advantage is that when in use as the zero instrument in an a.c. bridge, the sound strength obtained by the application of the sliding contact from the zero point increases much more rapidly than with ordinary receivers. The application of the instrument to multiplex telegraphy is also discussed. E. T. A. R.

2157. Dispersion and Absorption of High-Frequency Sound Waves. K. F. Herzfeld and F. O. Rice. *Phys. Rev.* 31. *pp.* 691–695, *April*, 1928.

The absorption of sound waves in gases has been explained hitherto by friction and heat conduction. A third factor is here introduced, namely, the slow rate of exchange of energy between the translational movement and the internal degrees of freedom of the molecules. The formulæ determining the absorption and dispersion of sound waves, due to these three effects, are developed. Comparison with the experimental data available shows that the new effect is either of considerable influence or even predominant. The rate of exchange can be calculated. AUTHORS.

2158. Acoustical Phenomena Illustrated by Ripples. Transmission through Quincke Filters, Curved Conduits and Vibrating Partitions. A. H. Davis. *Phys. Soc., Proc.* 40. *pp.* 90–93; *Disc.*, 93–94, *April*, 1928.

The paper employs ripple photographs to illustrate the action of the Quincke acoustical filter, and draws attention to the filtering action which is likely to occur at bends in curved sound conduits or in curved horns owing to resonant transverse vibration of the contained air. It also illustrates by the ripple analogy the transmission of sound through partitions, showing how the characteristics of the transmission may vary as the natural frequency of the partition is raised. [See also Abstract 1876 (1926).] AUTHOR.

2159. Calculation of Sound Energy. V. Weisskopf. *Phys. Zeits.* 29. *pp.* 302–304, *May* 15, 1928.

A critical examination of the method of making the above calculation. When deriving the expression for the rate of flow of energy in a plane wave of sound, writers have hitherto neglected second order variations in pressure and volume. It is shown that this procedure is not justified, that the potential energy of a sound wave as calculated from hydrodynamical equations is not single-valued, and that second order terms vary according as the source of sound produces changes in pressure, volume or velocity. G. E. A.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

2160. Maxwell's Equations in the Theory Common to Gravitation and Electricity. L. Infeld. *Comptes Rendus*, 186. *pp.* 1280–1282, *May* 7, 1928.

The theory of gravitation and electricity developed in a previous paper [see Abstract 1513 (1928)] and based upon a non-Riemannian geometry is shown to yield an expression for Maxwell's equations in tensor form which reduces to the ordinary wave equation in the absence of an electric current and in a suitable system of local coordinates. J. S. G. T.

2161. Triboelectric Effect between Solids and Gases. E. Perucca. *Comptes Rendus*, 186. *pp.* 850–853, *March* 26, 1928.

Describes a case of frictional electrification of a solid by a gas in a high vacuum. The gas is mercury vapour from a drop of mercury kept at about 100° C. The electrification is measured by an iron collector in contact with an electrometer. The collector can be heated electrically to about 200° C. A comparison made between this electrification and electrification produced by small mercury drops in the same vessel and with the same collector shows that the action of a jet of vapour is not a Volta effect, but a true effect of frictional electrification. E. E. F. d'A.

2162. Quantitative Measurements in Frictional Electricity. W. A. Macky. *Roy. Soc., Proc.* 119. *pp.* 107–132, *May* 1, 1928.

Two substances are rubbed together under definite conditions, and the resulting charge is measured. Only minute charges are obtained as the result of simple contact. For given specimens the charge increases with the amount of rubbing, up to a fairly definite maximum. The dielectric strength of the medium in which the experiment is performed is shown to be a very important factor. The experiments do not support the Helmholtz contact theory or Coehn's relation between charge and dielectric constant. References are given to a great deal of recent work on frictional electricity. [See also Abstract 1671 (1928).] H. R. R.

2163. Researches on Frictional Electricity. Part II. A New Effect. J. Tagger. *Phys. Zeits.* 29. *pp.* 304–308, *May* 15, 1928.

The production of electricity by the impact of solids [see Abstract 2588 (1927)] raises the question whether electrification of a solid may be produced by the impact of the molecules in a mass of air. To demonstrate this effect, the surface layer of gas on the solid must first be removed. The apparatus consisted of a horizontal helix of chrome-nickel wire connected to two thick upright copper wires. These were supported and insulated and dipped into mercury cups connected to the poles of a battery. On withdrawing the cups, one copper wire, connected to a quadrant electrometer and through the mercury to an earthed pole of the battery, was released last. After release, a charge grew on the spiral which depended on the temperature. With high temperatures a potential of 30 volts could be reached. The effect is apparently connected with the melting point of the metal. A platinum spiral gave a negative potential, and copper and nickel were electrified to positive potentials after fusing. [See also Abstract 143 (1926).] G. E. A.

DISCHARGE AND OSCILLATIONS.

2164. Auto-Electronic Discharge. N. A. de Bruyne. *Phil. Mag.* 5. *pp.* 574–580, *March*, 1928.

A clean tungsten kathode of small diameter was produced by burning out a tungsten filament. The auto-electronic currents from this kathode in a high vacuum were found to be reproducible provided the voltage was not carried too high. The currents were decreased in the presence of hydrogen and still more by air; they were increased by coating the kathode with barium. It is concluded that auto-electronic currents are not due to gas, but that they depend on the nature of the kathode in somewhat the same way as the thermionic emission. This conclusion is consistent with Schottky's theory, which, however, seems not to explain why the auto-electronic current should be almost independent of the temperature while the thermionic current varies so rapidly with it. It is not consistent with del Rosario's theory [see Abstract 1844 (1927)] that auto-electronic currents are due to traces of residual gas. [See also Abstract 1437 (1926).] A. W.

2165. Electrodeless Discharge through Gases. J. J. Thomson. *Phys. Soc., Proc.* 40. *pp.* 79–89, *April*, 1928. *Guthrie Lecture.*

The theory of the electrodeless discharge is given, which is followed by an account of the effect of light on the discharge. When light is sent through the tube in which the discharge is taking place and care is taken to prevent the light striking the walls of the tube in the neighbourhood of the ring discharge, a ring discharge of considerable luminosity is obtained if the applied potential was previously adjusted so that the ring discharge just ceased to pass through the gas. This effect was found in a great variety of gases. It is not so apparent when the pressure is very low as at somewhat higher pressures. The pressure at which the effect is a maximum depends on the nature of the gas; it is higher for the lighter gases than for the heavier ones. The effect is due to the absorption of ultra-violet light. The effect on the ring discharge of impurities in the gas is next dealt with. The presence of sulphur or phosphorus produces large effects. Appreciable effects are also produced by deposits of silver, platinum and cadmium. The effect, if any, produced by graphite was much smaller than with other substances. The cause of such effects is discussed, and possible explanations are given. The paper concludes with an account of various chemical effects produced by the ring discharge. [See also Abstract 702 (1928).]

A. W.

2166. Potential Required to Start the Glow Discharge. H. Alterthum, M. Reger and R. Seeliger. *Zeits. f. tech. Phys.* 9. 5. *pp.* 161–172, 1928.

A discussion is first given of previous work on this subject. Experimental work is then described on tubes containing various gases at different pressures. The gases investigated included hydrogen, argon, neon, nitrogen and mixtures of several pairs of these in varying proportions. An interesting series of diagrams is given showing the effect of increased pressure and, in the mixtures, of variation of the proportion of the constituent gases. A systematic investigation was made of the effect of impurities. A. W.

2167. High-Frequency Glow Discharge in Hydrogen. E. Hiedemann. *Ann. d. Physik,* 85. 6. *pp.* 649–686, *April* 17, 1928.

The behaviour of the glow discharge excited by damped oscillations is different from the behaviour of the high-frequency glow discharge excited by oscillations of sine form given by a valve generator, whether such waves are pure undamped oscillations or are modulated by means of a 50-cycle sine wave. The characteristics of the latter type of glow discharge were investigated for oxygen, air, nitrogen, argon, and especially hydrogen. A feature of the phenomena observed is the sharp separation of the different phases of the discharge. A new dark space was found with the above gases; it appears shortly before the disappearance of the positive column and divides the positive column into two symmetrical halves. This dark space is characteristic of the high-frequency glow discharge in tubes with two electrodes. The high-frequency glow discharge is specially suitable for investigating luminosity in gases at low pressures, since it can be obtained at pressures as low as 0·0001 mm. and, by the use of a magnetic field, at even lower pressures. In the case of hydrogen a striated type of discharge was observed. The condition for the formation of striæ was the use of sine-form oscillations of sufficiently high power. Typical photographs are reproduced. Measurements were made of the " layer " potentials in the high-frequency glow discharge in hydrogen. For one kind of striated discharge the potential found was between 15·6 and 18·4 volts, and therefore approximates to the ionisation potential of the hydrogen molecule. For the second type of striated discharge the potentials found were 10·6 ± 0·5 and 13·5 ± 0·5 volts. These are identical with the excitation potential and the ionisation potential of the hydrogen atom. [See also Abstract 357 (1926).] A. W.

2168. Primary Dark Space of a Geissler Discharge. K. G. Emeléus and Nora M. Carmichael. *Phil. Mag.* 5. *pp.* 1039–1048, *May,* 1928.

The primary dark space on the cold kathode of a Geissler discharge is similar in appearance to the positive ion sheaths present on negative exploring electrodes. A number of its properties can be accounted for by the application of the equations developed by Langmuir for the latter, but there are discrepancies between the observed and calculated current densities which indicate that the kathode is receiving fast electrons from adjacent parts of the discharge which, in turn, could produce a secondary emission of electrons from the metal. The primary dark space may be the analogue in a glow discharge of the kathode sheath in an arc. A. W.

2169. Electrical Breakdown of Gases at Atmospheric Pressures. L. B. Loeb. *Frank. Inst., J.* 205. *pp.* 305–321, *March,* 1928.

After a brief summary and discussion of Townsend's theory of the electrical breakdown of gases in the light of certain recent criticisms, it is shown that these are compatible with his theory except for one serious discrepancy. This discrepancy lies in the fact that at the assumed fields at which breakdown occurs in air, at atmospheric pressure, and in inert gases at low pressures, the β/p of Townsend's theory cannot have the significance given it by Townsend, as the positive ions are incapable at these fields of acquiring the ionising energy. Various solutions proposed are discussed and found inadequate. It seems necessary, in order to keep this otherwise successful theory, to doubt the validity of the assumption generally made for plane parallel electrodes that the potential drop between the plates is uniform before the spark passes. If fields about ten times as great as those calculated from the uniform drop existed, the theory could be applied. It is shown that such fields are possible under the conditions of the spark potential experiments, due to space charges resulting from the difference of ionic and electronic velocities. The existence of such fields requires a finite spark-lag interval of about 10^{-4} second, as yet not definitely observed. E. E. F. d'A.

2170. Ions and Electrons in Vacuum Electric Lamps. P. Selényi. *Phys. Zeits.* 29. *pp.* 311–318, *May* 15, 1928. *Report read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

The various ionic and electronic phenomena which occur in the vacuum electric lamp are briefly described by the author. When the lamp is alight the electronic current between the leading-in wires produces a stream of positive ions, which is dependent on the pressure of the residual gas or on the value of the electronic current. This electronic current is termed the "inner" electronic current, whilst the "outer" electron current is that which is measured between the outside of the bulb and the positive side of the lamp cap. After describing an electrostatic method of showing thermionic emission in a vacuum lamp and the proof of "inner" electron emission, the effect of magnetic and electrostatic forces on these inner electrons is discussed. It is then shown how the vacuum electric lamp can function as a three-electrode valve, a rectifier, a magnetron, a voltameter and a photoelectric cell. The electronic emission plays a part in the above applications of the electric lamp. Using the "outer" electron current, a method of demonstrating whether the lamp filament, in a finished lamp, is thoriated or not is given. After a discussion on the stream of positive ions, which complicates the previously mentioned applications, the use of this ionic stream for the estimation of the vacuum in finished lamps is clearly demonstrated by means of various methods [see Abstract 2612 (1927)]. These are useful to electric lamp manufacturers, as is the thoriated filament test. Finally, the emission of oxygen by the electrolysis of the glass parts of the lamps is discussed, as well as the cold electronic discharge which can be obtained in the vacuum lamp. In the *Discussion*, **Ewest** stated that the electric lamp with a lead-free glass bulb could be used as an ionisation manometer. The ratio of the ionic stream to electronic current is proportional to the pressure in the lamp. R. C. F.

2171. Electrodeless Ring Current. G. Mierdel. *Ann. d. Physik*, 85. 5. *pp.* 612–640, *March* 19, 1928.

The author discusses the movements of ions in electric fields of very high frequency, and concludes in the case of the electrodeless ring current that electrons are the only ionising agent. The "clean-up" phenomenon is examined in hydrogen, nitrogen, oxygen and air. In all cases it is due to the formation of active modifications or chemical compounds which are adsorbed by the glass surface, especially when the latter is cold. Quite unexpectedly no diminution of pressure is found in argon. A spectroscopic examination of argon and nitrogen yields the radial distribution of intensity of the frequencies predicted by theory. In hydrogen, where the

dissociation is high, the Balmer series is strongly marked, and so is the continuous spectrum of hydrogen with a maximum far in the ultra-violet.
E. E. F. d'A.

2172. Thermal Emission and Reflection of Electrons by Metals. L. Nordheim. *Zeits. f. Phys.* 46. 11–12. *pp.* 833–855, 1928.

The Richardson-Dushman formula for thermionic electrons is derived from the assumption that the electrons form a gas in the interior of the metal which obeys the Fermi-Dirac statistics. This treatment yields the usual values of the constants with an additional factor involving the weight of the quantum condition and the mean coefficient of reflection for electrons at the surface. The reflection of electrons at surfaces and surface layers is then theoretically calculated with the aid of quantum mechanics. The necessary condition for a sensible reflection is a very strong potential drop in the surface layer. In the absence of this, something resembling the adiabatic theorem holds good. E. E. F. d'A.

2173. Ionisation Chamber for Gases. L. B. Loeb and A. M. Cravath. *J.O.S.A. and R.S.I.* 16. *pp.* 191–196, *March*, 1928.

Describes a convenient form of ionisation chamber which has conducting walls, is absolutely gastight, and is easily demountable. The electrodes can be adjusted from the outside, and the plates are visible. The essential new element lies in the attachment of the gauze and plate elements by means of a levelling plate to the cover which carries the collecting plate. The whole of the measuring system can thus be lifted out of the chamber as an assembled unit for cleaning and readjustment.
E. E. F. d'A.

2174. Oscillatory Ionisation Currents from Clouds of Cadmium-Oxide Particles. H. P. Walmsley. *Phil. Mag.* 5. *pp.* 561–573, *March*, 1928.

The ionisation currents from cadmium-oxide clouds dispersed from an arc were registered photographically, using the steady deflection method of measuring currents. The currents are found to fluctuate rapidly. It is concluded that the observed fluctuations represent time-changes in the density of ionisation throughout the cloud. It is suggested that each fluctuation is due to a group of unstable complexes which apparently possess the same average life. The current due to a group is conceived to be zero initially, to increase with time to a sharp maximum (corresponding to the fluctuation) at the mean time of disruption of the group, and afterwards to diminish steadily. The superposition of currents corresponding to successive groups of unstable particles gives the fluctuating current which is observed. A. W.

2175. Collisions between Electrons and Gas Molecules. I. Langmuir and H. A. Jones. *Phys. Rev.* 31. *pp.* 357–404, *March*, 1928.

Using a simple method in which positive ion sheaths serve as perfect grids, the authors have obtained data on the probability of various types of collisions occurring between Hg, H_2, N_2, He, Ne and A molecules and electrons of moderate velocity, *i.e.*, 30–250 volts. A theory is developed, and the mean angular deflection for elastic and inelastic collisions between electrons and gas molecules is calculated. Evidence on the mechanism of ionisation is presented. The current densities of the various Maxwellian groups of electrons and the average temperatures of these groups are calculated from the data, and are shown to be in good agreement with data obtained by using Langmuir and Mott Smith's probe-wire method. The current density of positive ions is measured by both plane and probe-wire collectors and the space potential both measured and calculated. The evidence in support of negative anode drops is pointed out and the ions flowing to the anode measured separately by means of a perforated collector. The maximum number of positive ions produced by an electron with a given velocity before losing its ionising power is measured and shown to be independent of current density and pressure, being dependent only on the velocity of the electron and the nature of the gas. The mean free path of high-velocity electrons (*i.e.*, above the ionising potential) for various types of collision can be evaluated from the probability data. The mean free path for the inelastic impact is calculated separately and independently of the reflection of electrons from the collectors. The small angular scattering of electrons is discussed in detail. Phenomena, similar to Langmuir's high-speed electrons in mercury vapour are observed, and the curves showing the energy transfer between primary electrons in H and A are given. The resonance and ionisation potentials observed in the work are also tabulated. E. E. F. d'A.

2176. Ion Rays. E. Weitkamp. *Phys. Zeits.* 29. *pp.* 217–223, *April* 15, 1928.

G. C. Schmidt [Abstract 2128 (1927)] showed that many salts emit positive ions at comparatively low temperatures. There is a distinct parallelism with the phenomena observed during the electrolysis of the solid salts. He inclined to the opinion that occluded gases are responsible for the greater part of the emission. The result of the present work shows that there is a parallelism between the melting point of a salt and the emission temperature. The decrease of current observed by Schmidt vanishes as soon as the salt reaches the melting point. The addition of graphite to the salt anodes reduces the emission ten or twenty times. The emission is increased by adding minute quantities of iodine. The presence of moisture increases the emission, but absolutely dry air produces no change. E. E. F. d'A.

2177. Influence of Gas on Photoelectric Sensitiveness. H. Klumb. *Zeits. f. Phys.* 47. 9–10. *pp.* 652–670, 1928.

Samples of tantalum, tungsten, molybdenum, nickel and palladium are freed from gas by incandescence in a vacuum. In all cases the heating shifts the limit of photoelectric excitation towards the shorter wave-lengths in the ultra-violet. The photo effect observed at the greater wave-lengths must be attributed to gaseous impurities, among which water vapour has a decisive effect. E. E. F. d'A.

2178. Distribution of Velocities of Photoelectrons. F. Herold. *Ann. d. Physik,* 85. 5. *pp.* 587–611, *March* 19, 1928.

In order to obtain exact values of the velocity, the method of the homogeneous field is combined with the measuring method of the central field. The electrons are liberated by light of wave-length 2540 Å. The distribution of velocities is determined for copper, platinum, aluminium and lamp-black. In the case of platinum the curves tend towards the higher velocities the more the metal is freed from gas. This is reversed at a further stage. Very thin platinum films and tungsten films are also examined. E. E. F. d'A.

2179. Passage of Electrons through Hydrogen at Low Pressures. H. Jones and R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 1. *pp.* 239–241, *April*, 1928.

The conditions were such that single encounters with H_2 molecules were by far the most probable. The electrons after passing through the gas went through a fine slit, and were bent by a uniform magnetic field on to a photographic film. A main full-velocity line was produced with one or more other lines of less velocity. The first was due to electrons which passed through the gas with no collisions or only elastic collisions; one of the others corresponded to a loss of 12·2 volts on collision; this seems to be due to the passage of the H_2 molecule from the ground state A_0 to one of the C states, the lower ones being the most probable. Above 16 volts a line appears corresponding to a loss of 9·1 volts; it is suggested that this is due to collisions with H_3, which may be formed under the conditions of the experiment. H. N. A.

2180. Passage of Electrons through Slits. R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 1. *pp.* 242–245, *April*, 1928.

Continues the investigation described in a paper by Brett and Whiddington [see Abstract 182 (1927)]. With an oxide-coated filament lines were obtained in the magnetic spectrum *in vacuo* at positions corresponding to 3·9, 9·6, 11·4, 19·8, 22·6, 26·4, 32·3, 38·7, 45·0 and up to 60 volts loss of energy; when pure platinum was used as the emitter the lines 4·0 and 7·5 alone were obtained. In the first series the strongest line is usually 11·4; and 22·6, 32·3 and 45·0 may be regarded as integral multiples of this. Wolfenden has observed a radiation potential of 11·2 volts associated with hydrogen in contact with copper (the slit was made in a copper foil); 22·6 would correspond to an electron which had suffered two collisions in the gas film on the copper. Suggestions are made as to the origins of some of the other lines. No definite conclusion can be reached as to whether the 9·6 line is due to oxygen; it may originate in collisions with H_3 at the slit jaws. The 3·9 line may possibly correspond to the transition $1^2S - 2^2P$ for copper, which works out to 3·8 volts; the 4-volt line with a pure platinum emitter may correspond to the same transition. Certain peculiarities with a tungsten emitter are described and investigated. An explanation for them is suggested. H. N. A.

2181. Measurement of the Displacement of Negative Carriers in Flames. E. Marx and P. Kappler. *Phys. Zeits.* 29. *pp.* 261–269, *May* 1, 1928.

Direct measurements were made of the displacement of the negative carriers in flames, and the dependence of the displacement on the metallic salt concentration in alkali salt flames and on the nature of the salt was investigated. The results are presented in a series of tables and diagrams, for which the original paper should be consulted. [See also Abstract 2577 (1925).] **Errata** (*ibid.* p. 320, May 15, 1928). A. W.

2182. Radiation from Place of Impact of Hydrogen Canal Rays on Metals. C. Gerthsen. *Ann. d. Physik*, 85. 7. *pp.* 881–912, *May* 2, 1928.

The possibility of exciting the natural radiation of metals by the impact of canal rays is first discussed. Experiments are then described in which, by optical reflection from a concave mirror, it is shown that a weak wave radiation is emitted when hydrogen canal rays impinge on metals, and that this radiation originates from the point of impact of the canal rays. It cannot, however, be decided with certainty whether this radiation is the natural radiation of the atom on which the ray impinges or an excitation of the Lyman series. The effect observed by J. J. Thomson is connected with reflected canal rays. [See also Abstract 2397 (1926).]

A. W.

2183. Valve Transmitter for Short Undamped Waves. L. Bergmann. *Ann. d. Physik*, 85. 7. *pp.* 961–966, *May* 2, 1928.

An arrangement is described by means of which oscillations of wave-length from 82 cm. to 100 cm. may be obtained, using a single valve. The valve employed was of the type TMC made by the Campagnie des Campes, Paris. In this valve only the filament leads pass through the valve cap, the leads from grid and anode being brought out through the walls of the bulb. The arrangement finally adopted was symmetrical with respect to the anode and grid terminals of the valve, short wires (parallel to one another) passing from these to the terminals of a small blocking condenser of 50 to 100 cm. capacity. From one side of this condenser connection was made to the anode battery through a small choke and from the other side to the filament through another choke. The parallel wires were 32 mm. apart, and by varying their length the wave-length generated could be varied between the limits stated above. The anode potential used was 600 volts. On the longer waves the energy was considerably greater than on the shorter ones. [See also Abstracts 1905 (1924) and 1374 (1928).]

A. W.

2184. Space-Charge Effects. E. W. B. Gill. *Phil. Mag.* 5. *pp.* 859–865, *May*, 1928. *Supplement.*

Phenomena associated with the space-charge between the grid and plate of a three-electrode gas-free valve in which the plate is slightly negative to the filament are investigated, in continuation of previous work. [See Abstract 1955 (1925).]

J. S. G. T.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2185. Electrical Conductivity according to Wave Mechanics. W. V. Houston. *Zeits. f. Phys.* 48. 7–8. *pp.* 449–468, 1928.

In Sommerfeld's theory of electronic conduction based on the Fermi-Dirac statistics [see Abstract 1368 (1928)], the free path of the electron is set equal to an arbitrary function of the velocity $l = l(v)$. In the present work the dependence of this function on the temperature is evaluated on the basis of wave mechanics. The eigen vibrations corresponding to the electrons can be split up into advancing and retreating waves which are diffracted similarly to X-rays by the crystal lattice. The wave-lengths for nearly all the electrons are, however, large compared with the lattice constant, and the electrons move without scattering, provided the lattice points (metallic ions) are at rest. This case corresponds to an infinite free path. With rise of temperature, the metallic ions take up temperature motion and the electron waves no longer annul completely by interference. In this way the motion of the electrons is affected by the temperature agitation of the ions. The conductivity is computed for the solid and fluid states and the change of conductivity with pressure is related to the elastic constants of the metal. A qualitative explanation of Mathiessen's rule is obtained and a discussion given of thermoelectric e.m.f. on the theory. W. S. S.

2186. New Method of Conductivity Measurement by Means of an Oscillating Valve Circuit. E. F. Burton and A. Pitt. *Phil. Mag.* 5. *pp.* 939–943, *May*, 1928. *Supplement.*

A single-valve self-oscillator has its anode and grid coils arranged coaxially and close together, the space inside the coils being occupied by a test-tube of the liquid under test. A variable condenser in parallel with the anode coil, having a range of 250 $\mu\mu$F, is used to adjust the oscillations to the most sensitive region, and the oscillating valve is connected to a valve detector through a coupling condenser. The rectifier has a galvanometer in its anode circuit, and the steady current is balanced out by a local p.d. Variations of conductivity of the liquid within the oscillator coils vary the frequency and so the rectified current as read on the galvanometer. The authors state that this deflection is due mainly to the conductivity and not its magnetic permeability. Considerable patience is required to set up the circuit in the most sensitive manner, but the conditions are then easily reproducible. This sensitive region is obtained by adjusting the oscillating condenser until it is near the value at which oscillations cease. Figures are given for the alteration of the galvanometer deflection when using a standard KCl solution of various proportions. Another table gives qualitative results with some organic liquids. A diagram of the circuit is added, with notes on the values of inductance, etc., used by the authors, and reference is made to the work of Belz [see Abstract 88 (1923)], who had noticed the magnetic effects of certain salts when inserted in an oscillating circuit. E. H. W. B.

2187. Construction of a Valve Oscillator for Use in Conductivity Measurements. J. W. Woolcock and D. M. Murray-Rust. *Phil. Mag.* 5. *pp.* 1130–1133, *May*, 1928.

A self-oscillator for use with a bridge for electrolytic conductivity tests is described. The authors consider that their oscillator, as made from common radio set parts, is superior to one of the other types of valve oscillator. A single valve is used, the anode and grid coils being connected together with the oscillatory condenser in parallel with both. The anode coil is connected to the anode battery through the primary of a multiratio iron-cored transformer so that the voltage applied to the bridge can be varied. Other details are: anode and grid coils " Igranic 1500 turns " in an adjustable holder, dull emitter valve of 70,000 ohms anode resistance and an amplification factor of 35. The whole is mounted in an iron box for screening. In order to obtain a good wave-form the coupling between the coils should be loose. In use the capacitances have to be balanced on the bridge as well as the resistances, or a true null point cannot be found. Then the authors find the bridge equally suitable for resistances of 100,000 or 1000 ohms. A somewhat similar oscillator has been described by Ulich. [See Abstract 1730 (1925).] E. H. W. B.

2188. Resistance of Copper. A. Broido. *Zeits. f. tech. Phys.* 9. 5. *pp.* 194–197, 1928.

Gives an historical *résumé* of the determinations of the electrical conductivity of pure copper and of the values adopted as standard in different countries at various times. The present accepted values are

$17 \cdot 24 \times 10^{-6}$ international ohm (International Electrotechnical Commission) and $17 \cdot 84 \times 10^{-6}$ (V.D.E.), both at 20° C. J. W. T. W.

2189. Resistance of Sputtered Films. R. S. Bartlett. *Phil. Mag.* 5. *pp.* 848–859, *May*, 1928. *Supplement.*

Experiments carried out principally with sputtered gold films and also with films of platinum, palladium, copper, silver, bismuth and tellurium show that the peculiar electrical properties of these films are attributable to (1) occluded gas which affects the high specific resistance of the films, and more especially the decrease of resistance with ageing; (2) a granular or irregular structure which is associated with the dependence of specific resistance on thickness and the negative ageing effect of very thin films; and (3) a state of tension in the film giving rise to a low or negative temperature coefficient of resistance. The ageing of sputtered films is shown to depend on the temperature to which the films are raised. The resistance decreases to a minimum value and then increases as the temperature is raised. J. S. G. T.

2190. Thermo Forces in Cold Worked Metals. W. F. Brandsma. *Zeits. f. Phys.* 48. 9–10. *pp.* 703–705, 1928.

The thermo forces which are created between cold worked and recrystallised metals in the form of rods are reproducible, postulating the same previous treatment in each case. The values of these forces increase with the degree of working and decrease with annealing at a definite temperature to a limiting value. Examples and curves are appended for copper wire. S. G. B.

2191. Bibliography on Piezoelectricity. W. G. Cady. *I.R.E., Proc.* 16. *pp.* 521–535, *April*, 1928.

2192. Investigation and Theory of Pyroelectricity. A. Meissner and R. Bechmann. *Zeits. f. tech. Phys.* 9. 5. *pp.* 175–186, 1928.

The pyroelectric moments of tourmaline and quartz have been investigated by a simple method. The surface which becomes positive under pressure is negative when the crystal plate is heated; when the temperature is not too high, the moment remains constant as long as the heating continues; on cooling a temperature is found at which the moment is zero; further cooling produces a positive moment. These effects are complicated at higher temperatures by the passage of electricity from the electrode to the crystal face; this is more marked in the case of quartz. The pyroelectric constant of quartz is 100 to 1000 times smaller than that of tourmaline, and varies greatly in different specimens. The effect in quartz is explained in terms of Meissner's theory of the structure of this substance [see Abstract 30 (1928)]. The concluding section contains a mathematical treatment of the observations. H. N. A.

2193. Theory of Electrostriction and its Experimental Control. G. Bruhat and M. Pauthenier. *Comptes Rendus*, 186. *pp.* 1289–1291, *May* 7, 1928.

Expressions are obtained for isothermal and adiabatic electrostriction as functions of the measurable quantities

$$\left(\frac{\partial \epsilon}{\partial p}\right)_{T,E}, \left(\frac{\partial \epsilon}{\partial T}\right)_{p,E}, \left(\frac{\partial n}{\partial p}\right)_{T,E}, \left(\frac{\partial n}{\partial T}\right)_{p,E}.$$

For isothermal conditions the changes of volume and refractive index, and for adiabatic conditions the changes of temperature and refractive index, are calculated. The formulæ obtained rather increase the differences found previously for CS_2 and C_6H_6, but for CCl_4 the agreement with experimental results is good. [See also Abstract 1195 (1925).] R. S. R.

2194. Nature of Dielectric Losses. A. Joffé. *Zeits. f. Phys.* 48. 3–4. *pp.* 288–292, 1928.

A further contribution to the discussion of the paper on the same subject by H. Schiller [see Abstract 2387 (1927)]. The paper shows that the theories deduced by Schiller from the work of Sinjelnikoff and Walther for the explanation of the dielectric losses by ionic conduction and the Joule heat equation is incorrect. The method of handling the subject by the two workers above mentioned is based on an unbounded material, and, as it is not yet fully published, Schiller was unaware of this fact. The author indicates the probable lines of the mathematical treatment of the subject to be published in a future work. S. G. B.

2195. Temperature Gradient of the Dielectric Constants of Some Gases at Various Pressures. H. A. Stuart. *Zeits. f. Phys.* 48. 9–10. *p.* 747, 1928.

Remarks on the paper by Miss Forró [see Abstract 1391 (1928)], in which she found an increase in the molecular polarisation of CO and CO_2 from pressures of 0 to 6 atmospheres, and supports this by a paper of P. Phillips. But Phillips's paper is founded on a diminution of the molecular refraction with increasing pressure, which diminution is so small that the molecular polarisation ought to remain practically constant. Besides, the molecular polarisation shows in all cases the most irregular fluctuations with pressure and temperature. A. D.

2196. Adaptation of Bifilar Oscillographs to the Study of Triode Lamps. A. Blondel. *Comptes Rendus,* 186. *pp.* 1034–1036, *April* 16, 1928.

The author enumerates the difficulties in the use of the bifilar oscillograph for frequencies other than low values and the use of kathodic oscillographs for higher frequencies. He then describes how a bifilar oscillograph can be adapted by the use of a transformer with a ratio of 1/10 or 1/20 to the registration of the varying currents in a triode lamp circuit. It gives a curve sufficiently near to that in the primary circuit containing the lamp, while increasing the sensitivity and yet not losing the qualities of simplicity and convenience. R. S. R.

2197. Absolute Measure of Coefficients of Influence (Mutual Electrostatic Capacity). R. Darbord. *Comptes Rendus,* 186. *pp.* 1282–1284, *May* 7, 1928.

A method for determining the capacity of an ionisation condenser is described. J. S. G. T.

2198. New Quick-Tuning Vibration Galvanometer with Calibrated Tuning. D. C. Gall. *Journ. Sci. Instruments,* 5. *pp.* 134–135, *April,* 1928.

2199. Simple Graphic Method for Determining Galvanometer and Fluxmeter Constants, and the Measurement of Intense Magnetic

Fields. A. Ferguson and E. J. Irons. *Phys. Soc., Proc.* 40. *pp.* 95–105; *Disc.*, 105–106, *April*, 1928.

This paper deals with methods for evaluating the principal construction constants of moving coil instruments by the graphical treatment of observations of the logarithmic decrement and its variation with circuit resistance. It also discusses the application of these methods to the measurement of intense magnetic fields. AUTHORS.

ALTERNATING CURRENTS AND MAGNETISM.

2200. Skin Effect in Cylindrical Conductors. M. J. O. Strutt. *Ann. d. Physik*, 85. 7. *pp.* 781–793, *May* 2, 1928.

The problem of the current distribution in a cylindrical conductor of cross-section of any shape reduces to the linear integral equation, $\sigma(x, y) = \frac{a^2}{2\pi}\iint \log_e (\overline{x-\xi}^2 + \overline{y-\eta}^2)^{\frac{1}{2}} . \sigma(\xi, \eta)\, d\xi\, d\eta +$ const., where the cylinder axis is parallel to OZ and $\sigma(x, y)$ is the current density at the point (x, y). The constant a is determined by the conductivity of the metal and the frequency. The integral equation is solved for the cases of (*a*) a circular cross-section, (*b*) a cross-section consisting of an infinitely long strip of constant width. The lack of agreement between calculations based on the assumption of a cross-section of type (*b*), and actual measurements for ribbon conductors, is discussed. At high frequencies the general problem reduces to a corresponding electrostatics problem, and this is solved for the case of an elliptic cylinder. By comparison with the measurements of Kennelly, Laws and Pierce, the conclusion is drawn that a conductor of elliptic cross-section possesses a higher a.c. resistance than a conductor of rectangular cross-section having the same d.c. resistance and a ratio, width to breath, equal to the axes ratio of the ellipse. The above is demonstrated only for high frequencies and large axes ratios.
W. S. S.

2201. Magnetic Field Variation and Characteristic Time Constant. M. J. O. Strutt. *Ann. d. Physik*, 85. 7. *pp.* 866–880, *May* 2, 1928.

The problem dealt with in this paper is that of calculating the magnetic field in a cylindrical conductor which is placed in an approximately homogeneous alternating external field. This is stated as a formula in the form of a linear integral equation. A general solution is deduced from this which can be applied taking into consideration the characteristics of the cross-section of the conductor in each case. The solution is deduced for plate-shaped, circular, rectangular, triangular and elliptical cross-sections. In the conclusion the influence of the characteristic time constant of the conductor on the Joule and magnetic energy is shown.
S. G. B.

2202. Linear Heredity. D. Graffi. *N. Cimento*, 5. *pp.* 53–71, *Feb.*, 1928.

General mathematical considerations, leading up to problems of magnetic induction, the apparent value of the velocity of propagation of magnetism, and elasticity. A theorem of Volterra's as to the impossibility of periodic motions, generalised and proved in a new way. A. D.

2203. Magnetic Intensity of Iron and Nickel at Low Temperatures. P. Weiss and R. Forrer. *Comptes Rendus*, 186. *pp*. 821–823, *March* 26, 1928.

The extrapolation of the saturation values for infinite fields and the absolute zero of temperature is briefly considered. The results under examination relate to specially pure samples of the metals. After making allowances for the effects of slight traces of impurities, it is concluded that the saturation intensity for a gramme atom of iron is 12,393 = 11 × 1126·3, and for a gramme atom of nickel is 3377 = 3 × 1126.
A. A. D.

2204. Magnetic Susceptibility of Aluminium. C. Chéneveau. *Comptes Rendus*, 186. *pp*. 1102–1104, *April* 23, 1928.

Two samples of very pure aluminium containing 0·06 % of iron were found to have a mean mass susceptibility given by $\chi \times 10^6 = 0{\cdot}58$. Other three specimens which contained 0·5 % of iron gave 0·59. This value should be more than three times as great, if the iron were in the ionic state as Fe'' or Fe'''. Since the published relations of susceptibility of aluminium to small iron content do not follow any simple law, it is concluded that the behaviour of iron in this case is quite different from its behaviour when in the metallic state or when ionised, and that, as in manganese steel, its usual magnetic quality is very much reduced. Aluminium free from iron is paramagnetic. G. E. A.

2205. Magnetic Susceptibility and Presumed Second Isoelectric Point of Gelatine. M. Fallot. *Comptes Rendus*, 186. *pp*. 1287–1288, *May* 7, 1928.

Certain physical properties of solutions of the proteins vary with the concentration of hydrogen-ions, and the colloids are apparently less stable for the critical value known as the isoelectric point. This point occurs in gelatine with a concentration of hydrogen-ions of 2×10^{-5}, corresponding to a *p*H value of 4·7, and it marks a minimum of viscosity, osmotic pressure and conductivity. Experiment shows that there is also a minimum of magnetic susceptibility at the same point, but that there is no other isoelectric point, a result in accordance with the conclusions of other experimenters. [See also Abstract 456 (1928).] G. E. A.

2206. Relation between Colour and Magnetic Properties of Ions. B. Malyscheff. *Ann. d. Physik*, 85. 7. *p*. 794. *May*, 1928.

The discussions of Joos [see Abstract 956 (1927)] are illustrated by reference to some measurements by the author of the magnetic susceptibilities of the carbonyls of the paramagnetic metals in the gaseous, fluid and solid states. The investigation of the magnetic susceptibility is of importance in determining the configuration and structure of the compound, these being then related to the colour properties, *e.g.*, nickel in nickel carbonyl is octavalent, and the compound, unlike other nickel compounds, is colourless, the conditions being thus favourable to the rare gas configuration. W. S. S.

2207. Paramagnetism. Magnetic Moments of the Ions of Elements in the Transition Group of the Periodic Table. D. M. Bose and H. G. Bhar. *Zeits. f. Phys*. 48. 9–10. *pp*. 716–721, 1928.

A record of the results of measurement on the Curie magnetic balance of the magnetic susceptibility of various salts, the cations of which occur in the transition groups of the periodic table. The number of their Weiss magnetons is compared with the values obtained from the Hund and Bose calculations. The ions of molybdenum, uranium and vanadium show that their magnetic moment is alone affected by their electron rotational impulse. Tantalum and thorium are examples of the case where, if no electron exists in the path of their azimuth quantum number of 3, they are both diamagnetic. In the case of tungsten the behaviour is closely allied to that of the alkaline earths. The table appended records the results fully, and shows that a qualitative explanation can be given for the magnetic moments of the chloride of the palladium and platinum groups. Further work is proceeding. S. G. B.

2208. Self-Registering Magnetometer for Technical Measurements in Greatly Disturbed Positions. E. Lehrer. *Zeits. f. tech. Phys.* **9. 4.** *pp.* **136–143, 1928.**

The instrument was designed for use in a factory where there are large magnetic and mechanical disturbances. The system of the Kohlrausch Holborn torsion magnetometer was employed, since this is not affected by magnetic disturbances. The marble plate carrying the magnetometer was hung on wires, and suitably damped, so that the magnetometer was not affected by the vibrations due to large gas engines running in the immediate neighbourhood. The instrument has been employed in the photographic registration of hysteresis loops, temperature-magnetisation curves and solidification curves (temperature plotted against time as a metal solidifies). H. N. A.

2209. Convenient Forms of Magnetometer. S. R. Williams and W. J. Eckert. *J.O.S.A. and R.S.I.* 16. *pp.* 203–207, *March*, 1928.

In both forms described use is made of the split bell-shaped magnet such as was formerly used in moving magnet galvanometers. These are best made from tungsten steel. The magnet is attached to a rigid metallic stem, and hangs in a high quality oil which damps the vibration. To the upper end of the stem (out of the oil) is attached the mirror, and the system is suspended from the torsion head by means of a phosphor-bronze wire. In one type the normal to the mirror is at 45° to the vertical. The light passes vertically downwards on to this mirror and is reflected horizontally. Deflections up to 90° can thus be used with convenience. A. A. D.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

2210. Measurement of the Excitability of the Vaso-Constrictor Nerves in the Human Subject. A. and B. Chauchard and J. Hurynowicz. *Comptes Rendus*, 186. *pp.* 797–799, *March* 19, 1928.

Arteries may be caused to contract under the influence of a mechanical shock upon the muscle walls or by application of an electrical current. In the latter case it is a question whether the contraction is due to direct stimulation of the muscle of the arterial walls or to stimulation of the vaso-constrictor nerve plexus of the walls. Methods of determining this question are discussed, and the author prefers a plethysmographic method in the human subject. The method is described, and the results indicate that the constriction is due to the intermediate action of the nerve plexus and not to direct muscular action. The use of the method in clinical work for the examination of cases suffering from vaso-motor disease is indicated. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

2211. Theory of Sorption. O. Schmidt. *Zeits. f. phys. Chem.* 133. 3–4. *pp.* 263–303, *April,* 1928.

A second paper on the mechanism of heterogeneous catalysis [see Abstract 641 (1926)], which is primarily a sorption process leading to an increase in concentration. The sorption of gases by solid and liquid materials is dealt with, and experiments are described on chabasite (a zeolite) which retains its crystal lattice when deprived of its water of crystallisation because the pores are extraordinarily small (of the order of gaseous molecules), further on charcoal, silica gel, dehydrated gypsum, powdered metals, some oxides and carbonates (chromium, uranium, vanadium, magnesium), all at 760 mm. Hg, but different temperatures. Diffusion experiments were made with caoutchouc membranes. For constant temperature (within the range 0° C. to 150° C.) the log of the volume of gas or vapour sorbed per unit sorbent surface is connected with the heat of evaporation (Trouton) by: $\log c = a\sqrt{\lambda} - b$, where a and b vary with the experimental conditions, provided the gas diameter be smaller than the mean pore diameter. The gases tested are H_2, N_2, CO, Ar, O_2, CH_4, C_2H_4, C_2H_6, CO_2, NH_3, for all of which the c is smaller at 100° than at 20°, but the differences are small for H and also for NH. The above equation was deduced by Eucken with the aid of the hysometric formula and by Jaquet on the Maxwell-Boltzmann rule; the author deduces it kinematically. The isobars of different gases for the same sorbent are characterised by the fact that the quotients of the c values for the same temperatures show a constant relation. This rule does not hold any longer when the molecular volume of the vapour to be absorbed exceeds the value 50. Certain hydrocarbons (above propylane) and alcohols are sorbed to a very small extent or not at all (ether, benzene, hexamethylene), whilst ethylene shows normal sorption by chabasite. The rule holds also for sorption of gases by some fluids (water, ethyl, alcohol) and colloids, but does not apply when there is chemical combination or when the gases are ionised. In the latter case the van der Waals' forces of attraction are strengthened by Coulomb forces, so that higher sorption values are found; this applies to hydrogen sorption by metals. The whole process taking place within the substance, the sorption is intermediate between absorption and adsorption, and the conditions of solid solutions are approached.

H. B.

2212. Surface Solutions; Law of Mariotte and Gay-Lussac. R. Delaplace. *J. de Physique et le Radium,* 9. *pp.* 111–120, *March,* 1928.

The results obtained by investigating the properties of the thin films formed when benzyl benzoate spreads on the surface of water are employed to develop the parallelism between liquids of two dimensions (monomolecular layers) and those of three dimensions, established by Marcelin [see Abstract 2374 (1925)]. The surface liquids are found to obey a law analogous to that of Mariotte, namely, pS = a constant, p being the surface pressure and S the area covered by the two-dimensional liquid. They follow also a law similar to Gay-Lussac's law, $pS = KT$, where K is a constant and T the absolute temperature. The value of K is independent of the nature of the solvent, and of the concentration of the benzyl benzoate, so that the hypothesis of a surface ultra-colloid must be excluded. A study of the law according to which the solvents (soluble or volatile) disappear from the surface of the water indicates the temporary formation of a thin film which gradually disappears, so that a few minutes must be allowed to elapse before the surface pressure of the insoluble floating molecules is measured. T. H. P.

2213. Gaseous Solutions. Merle Randall and B. Sosnick. *Am. Chem. Soc., J.* 50. *pp.* 967–980, *April*, 1928.

The application of the generalised statement of Raoult's law to gaseous solutions is elaborated, the deviations being found to be of the same nature as, but, in general, of less magnitude than, those of typical liquid pairs of like polarity. Investigation of the question of the fugacity of super-cooled vapour shows that, for pressures near that of the turning-point of the pressure-volume curve, the fugacity of the pure constituent should not be used for the Lewis and Randall rule (*Thermodynamics and the Free Energy of Chemical Substances*, 1923, Chapter XVII). This rule is found to hold as an approximation and a limiting law for gaseous solutions above the critical temperature of the gases, and, over a limited range of total pressures, for the solute gas below its critical temperature. For solute gases below their critical temperature, values of "activity coefficients" are calculated which permit of rough quantitative predictions of values in other mixtures and at other temperatures. T. H. P.

2214. A Physical Factor in the Liesegang Phenomenon. S. Ray. *Kolloid Zeits.* 44. *pp.* 277–279, *April*, 1928.

The author deduces a complex experimental relation between the density and the height of a colloidal solution, the curve of which resembles with its two humps a capital R. The result is that three different heights may correspond to the same density. This is observed, *e.g.*, in quinine suspensions containing too little citric acid and in phenol-water emulsions. The striations observed in silver deposits may have a similar origin, but are more likely connected with the makes and breaks in the induction apparatus, as they are not observed when the electric field (replacing the gravitation field in the other case) is produced by a Wimshurst machine. H. B.

2215. Influence of Difficultly Soluble Substances on the Thixotropic Change of Ferric Oxide Sols. H. Freundlich and K. Soellner. *Kolloid Zeits.* 44. *pp.* 309–313, *April*, 1928.

A series of experiments were made to determine the influence of metals on the thixotropic change of sols of Fe_2O_3 containing NaCl. It was found that the time of solidification was dependent upon the hydrogen-ion concentration, and that it increased as the H-ion concentration increased. Metals such as silver were found to pass into solution to a sufficient extent to diminish the H-ion concentration sufficiently to decrease the rapidity of solidification. Pure gold and platinum did not bring about a similar change, as insufficient metal passed into solution to diminish the H-ion concentration. This conclusion was confirmed by approximate experiments with a number of sparingly soluble substances—elements, oxides, sulphides and silicates. A striking difference was obtained between ordinary steel and a special steel, V2A, made by Krupp. Graphite, sulphur, talc were found to have little influence, while oxides such as hæmatite and magnetite had a distinct effect on the change. F. J. B.

2216. Colloids—Electrical Charges. R. Keller. *Kolloid Zeits.* **44.** *pp.* **324–326,** *April,* **1928.**

The colloid condition is characterised not only by the size of its particles but also by a minimum and a maximum electrostatic charge of these with reference to the dispersion medium. In and on colloids the mobility of ions of strong electrolytes is hampered, and the influence of ions (particularly those of strong acids and bases) is very small. A. D.

2217. Röntgenspectrographic Investigations on Celluloid. K. H. Ueda. *Zeits. f. phys. Chem.* **133. 5–6.** *pp.* **350–356,** *April,* **1928.**

From suitable solvents, such as pentane, nitrocellulose with a fibrous structure takes up camphor, and as the amount taken up increases the interference of the nitrocellulose lattice gradually disappears and becomes superposed by that of camphor to give an amorphous celluloid diagram. If the camphor is extracted again, the fibre diagram of the nitrocellulose reappears and does not differ markedly from the original diagram; only when very large proportions of camphor are taken up does the diagram of the amorphous nitrocellulose persist. The Röntgen diagram of technical celluloid consists of two intense and several faint Debye-Scherrer rings, being a superposition effect of the diagrams of the two components. The inner and strongest interference ring is displaced steadily towards the camphor interference as the camphor content rises. With a high camphor content (70 %), the diagram shows crystalline separation of camphor, and this phenomenon appears also with lower proportions of camphor if the celluloid is strongly expanded. The Röntgen diagrams indicate, not the existence of a stoichiometric relationship between the two celluloid components, but the existence of a solid solution. T. H. P.

2218. Electrical Resistance Measurements of the Atmospheric Corrosion of Metals. J. C. Hudson. *Phys. Soc., Proc.* **40.** *pp.* **107–129;** *Disc.,* **129–131,** *April,* **1928.**

This paper describes in detail an experimental procedure for quantitative field tests on the atmospheric corrosion of metals, which is based on the determination of the change in the electrical resistance of wire specimens produced on exposure. The method is capable of great accuracy, and the resistance changes produced in duplicate specimens agree to within 5 %. The validity of the results has been established, in the case of the metals investigated, by correlation with the corresponding weight changes of the specimens. In the case of copper, it has been found that the percentage resistance change due to corrosion is inversely proportional to the diameter of the wire; it is thus possible to use the method as an " acceleration test " by conducting experiments on relatively thin wires, which are appreciably affected by corrosion within a few weeks. AUTHOR.

2219. Feeble Additions of Tin and Cadmium to Lead. J. Cournot. *Comptes Rendus,* **186.** *pp.* **867–869,** *March* **26, 1928.**

Cadmium raises the strength and elastic limit of lead; tin has little effect on these qualities. Cadmium lowers the malleability; tin cures this defect. Cadmium renders the molten metal somewhat easily oxidised; tin remedies this fault. It is suggested that an addition of about 2 % of tin and 1 % of cadmium greatly improves the qualities of lead which is to be used industrially. A. A. D.

2220. Examination and Properties of Special Steels. F. Stäblein. *Zeits. f. tech. Phys.* 9. 4. *pp.* 145–147, 1928.

Examples are given of iron alloys showing special magnetic behaviour. The thermal expansion of nickel-steels is considered, and the effects of temperature and the addition of other elements on the specific resistance of iron are summarised. L. L. B.

2221. Systems Iron-Silicon, Iron-Chromium, Iron-Phosphorus. C. Kreutzer. *Zeits. f. Phys.* 48. 7–8. *pp.* 556–566, 1928.

An X-ray investigation has been made of the influence of silicon and chromium on the α-γ and γ-δ transformations of pure iron. The Debye-Scherrer diagrams of small heated rods of metal show that iron-silicon alloys containing up to 2·2 % silicon pass through the γ-region on heating from the α- to the δ-phase. For 2·2 to 2·5 % silicon the γ-region is replaced by an interval in which α- and γ-iron exist together. All alloys with more than 2·5 % silicon pass direct from the α- to the δ-state. Similar results were found with chromium alloys, the limiting position of the cut-off γ-region in the iron-chromium diagram occurring at about 15 % chromium. An investigation of the iron-chromium system at room-temperature with iron or chromium radiation showed that iron and chromium do not form a chemical compound, but no definite proof was obtained of the formation of an unbroken mixed-crystal series. An X-ray analysis of the system iron-phosphorus at room-temperature confirmed the following components: for 1·7 % phosphorus, saturated mixed crystals; for 15·58 and 21·5 % phosphorus, the compounds Fe_3P and Fe_2P_1 respectively; for 21·5 % phosphorus, an unknown compound. L. L. B.

2222. X-Ray Investigation of the Structure of the Oxides of Iron. H. Groebler. *Zeits. f. Phys.* 48. 7–8. *pp.* 567–570, 1928.

By analysing samples of different oxygen-content, prepared by the reduction of ferric oxide in atmospheres of carbon dioxide and carbon monoxide of varying composition at 800°, curves are obtained showing the relation between the oxygen-content of the solid phase and the carbon monoxide-content of the gas phase. The iron oxide samples were subjected to a röntgenographic investigation by the Debye-Scherrer method, using Kreutzer's apparatus [see preceding Abstract]. The results show that for a reduction temperature of 800°, magnetite can contain up to 5 % of ferrous oxide in solid solution. If a higher proportion of ferrous oxide is present it separates as a second solid phase, until at 39 % magnetite the magnetite lattice disappears and the ferrous oxide lattice remains unchanged up to 100 % ferrous oxide. The solubility of iron in ferrous oxide is extremely small. L. L. B.

2223. Present Position of the Theory of Centres of Activity in Heterogeneous Catalysis. F. H. Constable. *Cambridge Phil. Soc., Proc.* 24. *pp.* 291–306, *April,* 1928.

Consideration of this question indicates that there is evidence from many different branches of science to show that catalysis is due to the action of strong specific fields of force that emanate from special configurations of atoms upon the catalyst surface, and that the main outlines of the experimental facts dealing with adsorption and catalysis may be explained quantitatively on this basis. [See next Abstract.] T. H. P.

2224. Method of Generalising the Law of Mass Action for Heterogeneous Surface Reactions. F. H. Constable. *Cambridge Phil. Soc., Proc.* 24. *pp.* 307–314, *April,* 1928.

The effect of the mechanism of chemical action involved in the theory of centres of activity [see preceding Abstract] on the dynamics of heterogenerous reactions is considered. To the conditions of reaction in homogeneous systems is added that of the adsorption of the reactants on the centres of activity of the surface. The surface may be treated as if it were homogeneous, reaction taking place as if those centres on which the heat of activation is least were alone responsible for chemical change. A general equation is developed in terms of the rate of bombardment of the surface, and the mean lives of the molecules on the surface, and it is shown that the areas associated with the forward reaction must inevitably catalyse the reverse reaction. The general solution is impracticable, but the special cases of irreversible synthesis and decomposition may be dealt with in this way. T. H. P.

2225. Action of "Active" Nitrogen on Iodine Vapour. L. H. Easson and R. W. Armour. *Roy. Soc. Edinburgh, Proc.* 48. 1. *pp.* 1–9, 1927–1928.

Previous work on active nitrogen is briefly reviewed, with special reference to the origin of the "glow." The spectrum of the latter and the spectra of certain substances which it can excite support the theory that the glow is due to a recombination of atoms of nitrogen. Further evidence in favour of this hypothesis is now obtained from observations in the extreme ultra-violet of the spectrum of iodine excited by active nitrogen. Using a Hilger quartz spectrograph and a quartz plate, the line 185 $\mu\mu$ is observed, from which it is concluded that energy sufficient to dissociate the iodine and raise the atom to the level necessary to emit this line, $3500 + 154{,}000 = 189{,}000$ cal., or $1\cdot 7 + 6\cdot 7 = 8\cdot 4$ volts, is supplied by the nitrogen. It was found by experiment that the pressure of iodine required to produce nothing but iodine glow is of the order of 1/15 part of the active nitrogen present, and that if the velocity of the reaction with iodine is made so great that the effect of the decay of the active nitrogen could be neglected, then this velocity is too great to allow of its measurement by ordinary means L. L. B.

2226. Theory of the Combustion Process. N. Semenoff. *Zeits. f. Phys.* 48. 7–8. *pp.* 571–582, 1928.

The mechanism of the combustion process is approached from the standpoint of Arrhenius's theory of active and inactive molecules. Two possible mechanisms of reactions which proceed with explosive violence are considered: (1) the reaction is due to a combination of the heat evolved in the reaction and a chain-reaction mechanism, and (2) it is due to a chain reaction with an infinitely rising reaction velocity. Formulæ are developed for case (1) which are considered to be exact, and it is shown that at any given temperature there is a critical density at the surface of the vessel above which the mixture explodes, and for each density of the mixture a surface temperature can be found above which the mixture explodes. The critical density decreases rapidly with increase of temperature. Case (2), developed from the standpoint of activation by molecular collision, leads to the result that $\alpha \geq 1$ is the condition for the combustion process to occur, where $\alpha = \beta \, . \, a/(a + b)$, β being the probability of certain activation processes occurring and a and b the concentrations of the reacting molecules. L. L. B.

2227. Auto-Oxidation During Slow Combustion. E. W. J. Mardles. *Chem. Soc., J. pp.* 872–885, *April*, 1928.

The slow combustion of hexane vapour to which measured quantities of benzene, aniline, etc., were added, was investigated from the standpoint of the auto-oxidation of the added substances. The reactions were studied by the "tube" method of Callendar and by the "bulb" method, in which the reaction mixture was heated in a bulb tube connected to a manometer. It was found that the yield of active oxygen obtained during the slow oxidation of fuel-air mixtures is greatly diminished by heating for a longer time than is required for the initial formation of the peroxide. The activity of the primary peroxides formed in hexane-air mixtures or ether-air mixtures is demonstrated by the auto-oxidation of benzene and aniline, which occurs readily in the presence of hexane and ether, but cannot be induced at the same low temperatures in their absence. The presence of hydrogen peroxide produced from combustion is a decomposition product of more active and unstable peroxides. The work confirms the view that the detonation of an engine using liquid fuel is due to the formation of organic peroxides, which become concentrated in the nuclear drops during compression and ignite simultaneously when the ignition temperature of the peroxide is reached. The addition of detonation-inducers to a variety of fuels showed that the temperature of spontaneous ignition was lowered in all cases, and detonation-preventers, such as certain organo-metallic compounds, had the opposite effect. F. J. B.

2228. Burning of Carbon Disulphide. Part II. Velocity of the Uniform Movement of Flame in Carbon Disulphide-Second Combustible-Air Mixtures. A. G. White. *Chem. Soc., J. pp.* 751–763, *April*, 1928.

It was found previously [see Abstract 2417 (1927)] that, near the limits for the propagation of flame, the burning of carbon disulphide is markedly hindered by the presence of any one of a very large number of other combustibles, the presumption being that the limit combustion of carbon disulphide is catalysed, probably by some product of the combustion. Results are now recorded of flame-speed determinations, under uniform movement conditions, for carbon disulphide-air and carbon disulphide-second combustible-air mixtures. Certain carbon disulphide-air mixtures have two widely differing flame speeds producible at will by varying the conditions of ignition, these two types of flame, cool and ordinary, giving different lower limits. The presence of certain other combustibles hinders the burning of carbon disulphide in air throughout its propagation range. In dilute carbon disulphide-air mixtures flame speeds are far more sensitive to oxygen content than in similar mixtures of normal combustibles. The law of flame speeds is not applicable to mixtures containing carbon disulphide, and it is concluded that the normal burning of carbon disulphide in air is catalysed, probably by a product of its combustion, and that such catalysis is inhibited by the presence of material quantities of any one of a large number of other combustibles. T. H. P.

2229. Oxidation of *n*-Hexane. M. Brunner and E. K. Rideal. *Chem. Soc., J. pp.* 1162–1170, *May,* 1928.

The process of oxidation of *n*-hexane bears a striking similarity to the auto-oxidation of benzaldehyde. The temperature of initial combustion is not a characteristic of the hydrocarbon, for rapid combustion will set in after a period of induction at lower temperatures. During this induction period slow auto-oxidation proceeds together with formation of peroxides. At constant temperature the length of period of induction is greatly affected by the oxygen pressure and by the presence of inhibitors, such as aniline, or of surface catalysts, such as pumice. The temperature coefficients of the reactions proceeding in the induction period are high. It is suggested that the reactions involve the formation at catalytic surfaces of an active moloxide, which is subsequently converted into a stable peroxide. This can react either in the gaseous phase or at the surface, but when the peroxide concentration reaches a critical value chain propagation ensues, causing excitation and combustion of molecules coming into contact with the reaction centres of the chain. T. H. P.

2230. Effect of Anti-Detonants in the Vapour Phase. Aubert, Dumanois and Pignot. *Comptes Rendus,* 186. *pp.* 1298–1299, *May* 7, 1928.

It has been shown previously [see Abstract 1611 (1926)] that anti-detonants, including tetra-ethyl lead, have no sensible influence on the temperature of inflammation of a mixture fired by adiabatic compression. Experiments are now described which had the object of discovering any possible action of the anti-detonant in the gaseous phase in a retardation of the rate of combustion of a mixture of air and hexane. Photographic records of time and pressure have been obtained, the compression ratio being 8·25 to 1 and the temperature before compression 50° C. It is found that the time from inflammation to maximum pressure is considerably increased when such an anti-detonant as tetra-ethyl lead or toluidine is employed. The proportion of the "dope" used is 5 %, which is greatly in excess of that utilised in internal combustion engines. In explanation it is suggested that the combustion of the mixture is a succession of oxidations more and more profound, and that the function of the anti-detonant is to assure a more complete evolution of each of the successive phases. T. B.

2231. The *p*H of Buffered Salt Solutions. J. B. O'Sullivan. *Faraday Soc., Trans.* 24. *pp.* 298–300, *May,* 1928.

The object of this paper is to show the need for checking the *p*H of buffer solutions after the addition of salts. Reference is made to the work of Haynes, who showed that the *p*H of acetate and phosphate buffer solutions is lowered by the addition of such "neutral" salts as the chlorides of the alkalis and of barium, calcium and magnesium. In addition to confirming these results, the present author also investigated in detail the effect of cadmium chloride, nickel sulphate and aluminium nitrate over a wide range of concentration of these salts. J. K.

2232. Activity Coefficients of Aqueous Solutions of Lead Chloride at 25° C. A. J. Allmand and E. Hunter. *Faraday Soc., Trans.* 24. *pp.* 300–306, *May*, 1928.

Reference is made to an earlier paper [see Abstract 3232 (1927)] on an electrometric investigation of the system $PbCl_2$–KCl–H_2O at 25°, wherein it was mentioned that measurements on the cell Pb (amalgamated) | aqueous $PbCl_2$ | AgCl (solid) | Ag had given discordant results. The measurements for this element are now given under air-free conditions at 25° C. between the concentration limits of saturation and 0·00006 molar. From these results the mean activity coefficients of the dissolved lead chloride are calculated between the concentration limits of saturation and 0·0003 molar, and agreement with Lewis and Randall's deductions from Brönsted's earlier measurements is very fair. J. K.

2233. Activity Coefficients of Hydrogen Chloride in Ethyl Alcohol. J. W. Woolcock and H. Hartley. *Phil. Mag.* 5. *pp.* 1133–1144, *May*, 1928.

Reference is made to the work of Danner [see Abstract 597 (1923)], who measured the electromotive force of the cell H_2 | HCl in ethyl alcohol | Hg Cl : Hg, and of Harned and Fleysher, who investigated the cell H_2 | HCl in ethyl alcohol | Ag Cl : Ag. A discrepancy between these two investigations resulted which the present authors are able to explain from the data obtained in their redetermination of the electromotive force at 25° C. of the AgCl cell. The activity coefficient in the range 0·0003 m. to 0·004 m. is represented by $-\log f = 3{\cdot}40C^{\frac{1}{2}}$, the value of the coefficient being greater than that demanded by the Debye theory. J. K.

2234. Calomel and Silver Chloride Electrodes in Acid and Neutral Solutions. Activity Coefficient of Aqueous Hydrochloric Acid and the Single Potential of the Decimolal Calomel Electrode. Merle Randall and Leona E. Young. *Am. Chem. Soc., J.* 50. *pp.* 989–1004, *April*, 1928.

The value, 0·3989 volt, generally accepted as the potential of the 0·1 M hydrogen calomel cell at 25°, is shown to be too high, the results of its measurements being vitiated by the presence of air, which causes errors of 0·001 to 0·003 volt; the true value is 0·3976 volt. Dilute HCl containing dissolved air reacts with metallic mercury to form calomel, but from the potential of the hydrogen-calomel cell it is predicted that the air-free acid will not react unless its concentration exceeds 11·62 M. Air does not seriously affect the potential of the mercury-calomel electrode in neutral solutions. Conclusions regarding the most probable values of the activity coefficients of HCl up to 16 M solutions and of the activity of the water in such solutions are drawn from a consideration of previous determinations of freezing point, vapour pressure and electromotive force, and new values for certain important reference electrodes are calculated. The conditions for the preparation of reproducible silver-silver chloride electrodes have been studied. The free energy of formation of hydrogen chloride from the gaseous elements is − 31,345 (aq.) or − 22,741 (gas) cal. T. H. P.

2235. Differential Potentiometric Titration. Part I. Simple Method (No. 1). B. Cavanagh. *Chem. Soc., J. pp.* 843–855, *April*, 1928.

A method of potentiometric titration was developed in which the measurement of a single potential change produced by the addition of an arbitrary quantity of reagent was sufficient to give the desired result by reference to tables given in the text. The applicability of the method, the limit of precision, and results of titrations of varying concentrations of KCl with AgNO are given. F. J. B.

2236. Differential Potentiometric Titration. Part II. Refined Methods (Nos. 2 and 3). B. Cavanagh. *Chem. Soc., J. pp.* 855–872, *April*, 1928.

The work of the previous paper [see preceding Abstract] is continued. The equation of the titration curve is derived by the aid of hyperbolic functions. The three methods are discussed. Method 1 is applicable to all ordinary cases; method 2 is essentially for very dilute solutions, and is an extension of method 1; method 3 is independent of a constant of the equation, and from two potential changes produced by two successive additions of reagent, the result of the titration is accurately obtained, either by a calculation with the aid of tables which are given, or by the use of curves. F. J. B.

2237. Smooth Platinum Wire for Electrometric Titrations in Neutralisation Reactions. S. Popoff and M. J. McHenry. *Indust. and Engin. Chem.* 20. *pp.* 534–538, *May* 1, 1928.

The determination of total acidity or total basicity in the presence of oxidising agents, metal ions, phenol, cresol and varnish is of special importance in many theoretical and practical problems. The usual methods, which employ the hydrogen, quinhydrone, air, or glass electrode, and the conductivity method are often too cumbersome or long, or give rise to errors too large to be disregarded. Tests made with an electrometric method by means of a smooth platinum wire instead of the hydrogen electrode yield excellent results under conditions which render other physico-chemical analytical methods either useless or impracticable. The breaks at the end-point are sufficient to allow of the determination of total acidity or basicity with precision exceeding that of the most sensitive indicator method; with solutions as dilute as 0·01 *N* readings to within 0·01 c.c. are obtainable in presence of permanganate. Tungsten wire in place of platinum wire gives good results, but the break at the end-point is smaller. The method is applicable to the determination of total acidity in presence of phenol, cresol, and varnish. The alkaloids or their salts may be determined electrometrically more accurately than otherwise, and the titration curves are given. T. H. P.

2238. Perphosphoric Acids and Perphosphates. S. Husain and J. R. Partington. *Faraday Soc., Trans.* 24. *pp.* 235–245, *April*, 1928.

Perphosphoric acids are not obtained by the action of 30 % hydrogen peroxide at 0° on phosphorus oxychloride, but most of the alkali and alkaline earth phosphates react, giving definite compounds containing hydrogen peroxide of crystallisation. Primary phosphates of lithium, ammonium, calcium, and strontium and phosphates of thallium do not react, and tertiary potassium phosphate decomposes the peroxide. There is no evident relationship between the water of crystallisation and the hydrogen peroxide of crystallisation, but the alkalinity of the phosphate appears to be related to the formation of compounds containing hydrogen peroxide of crystallisation. Phosphates with acid reactions, such as primary phosphates, either fail to react, or give unstable compounds, with the peroxide. Slightly acid phosphates, like secondary phosphates of alkaline earths, give unstable compounds and alkaline phosphates rather stable compounds, whereas strongly alkaline phosphates decompose hydrogen peroxide. Electrolysis at a low temperature of orthophosphoric acid, or of lithium, sodium, or thallium phosphates with a low anodic and a high kathodic current density and in presence of a little chromate to prevent kathodic reduction, does not yield perphosphates, whilst secondary phosphates of potassium, rubidium, cæsium, and ammonium give permonophosphate and perphosphate in solution. The tendency towards formation of perphosphate by electrolysis of alkali phosphate increases with increase in the atomic volume of the alkali metal. Comparison of the two sets of products, one obtained by electrolysis and the other by the action of hydrogen peroxide, shows that the former compounds are true perphosphates, and the latter compounds containing hydrogen peroxide of crystallisation. T. H. P.

2239. Electrical Conductance of Nickel Sulphate Solution and the Ionic Conductance of Nickel. K. Murata. *Chem. Soc. Japan, Bull.* 3. *pp.* 47–53, *Feb.*, 1928.

The conductance of aqueous solutions of nickel sulphate at concentrations varying from 0·0001 to 1 equivalent per litre at temperatures of 18° C. and 25° C. was measured. The conductivity at infinite dilution was found. The ionic conductances of nickel were calculated. The relative viscosity and the degree of ionisation of 1/20 mol. nickel sulphate were calculated. F. J. B.

2240. Maxima on Current-Voltage Curves. Part I. Electrolysis of Nickel Salt Solutions with the Mercury Dropping Electrode. N. V. Emelianova and J. Heyrovský. *Faraday Soc., Trans.* 24. *pp.* 257–267; *Disc.*, 279–281, *May*, 1928.

The electrodeposition of nickel from nickel salt solutions was studied by means of the polarisation curves of electro-reductions obtained with the mercury dropping kathode. The maximum only appears when the solutions are freed from oxygen. The phenomenon of the maximum was shown to be due to the adsorption of reducible matter at the mercury solution interface, and the suppression of maximum to be due to the replacement of the reducible ions by more adsorbable matter. The sudden fall of the current after the maximum was explained by the concentration polarisation, which starts when the velocity of deposition of ions is greater than the velocity of adsorption in the surface film at the mercury dropping kathode. F. J. B.

2241. Maxima on Current-Voltage Curves. Part II. Maxima on the Polarisation Curves of Uranyl Salt Solutions. P. Herasymenko. *Faraday Soc., Trans.* 24. *pp.* 267–272; *Disc.*, 279–281, *May*, 1928.

The maxima on the current voltage curves accompanying the first stage of reduction of uranyl ions in aqueous solutions were described. The addition of indifferent salts was found to exert a great effect on the intensity of the maximum reduction current. The suppressive action was dependent only on the total number of electric charges in solution, so that equivalent quantities of ions of different valencies produced the same effect. The intensities of the ascending currents is probably due to the velocity of adsorption of uranyl ions as well as to the rate of diffusion. The sudden decrease of current was considered to be due to the formation of an interfacial film of solution exhausted of uranyl ions, which prevented adsorption. The current after the maximum falls to a saturation current due to diffusion of ions only. F. J. B.

2242. Electroreduction of Uranyl Salts by the Mercury Dropping Electrode. P. Herasymenko. *Faraday Soc., Trans.* 24. *pp.* 272–279; *Disc.*, 279–281, *May*, 1928.

The reduction of uranyl salts by the dropping mercury electrode was found to take place in three stages. The first stage of the reduction potential depended upon the concentration of uranyl ions, and was not influenced by the concentration of hydrions. The displacement of the reduction potential on dilution indicated that the uranyl ions were reduced to pentavalent uranium. The two subsequent stages of the reduction, $U^{V} \rightarrow U^{IV}$ and $U^{IV} \rightarrow U^{III}$, were indicated by more negative potentials; at still greater kathode potentials hydrogen ions were finally deposited. F. J. B.

2243. Activity of Hydrogen Ions in Aqueous Solutions of Beryllium Sulphate. M. Prytz. *Faraday Soc., Trans.* 24. *pp.* 281–288, *May*, 1928.

Determinations of values for *p*H in solutions of beryllium sulphate were made, by means of the hydrogen electrode, at different concentrations and temperatures. A similar series of measurements were made for mixed solutions which contained $BeSO_4$ and H_2SO_4. The results were discussed in relation to the hydrogen ion activities and the effect of the ions of the salt on these activities. An attempt was made to ascertain the percentage hydrolysis of $BeSO_4$ by comparing solutions of $BeSO_4$ with equimolecular solutions of $MgSO_4$ containing sufficient H_2SO_4 to yield the same values of *p*H. F. J. B.

2244. Electrolysis of Fused Salts of the Heavy Metals. Part II. Iron, Chromium, Manganese obtained from Oxides and Silicates. G. Neuendorff and F. Sauerwald. *Zeits. f. Elektrochem.* 34. *pp.* 199–204, *April*, 1928.

Continuing the work previously carried out on the electrolysis of fused salts of the heavy metals [see Abstract 904 (1926)], the electrolysis of fused salts, chiefly oxides with the addition of silica, of iron, chromium and manganese was studied. The results showed that it was possible to prepare carbon free iron, steel, and cast iron by varying the conditions of the electrolysis. High current yields were obtained by maintaining a higher temperature in the apparatus. Chrome iron ore was electrolysed in a similar way, and high current yields were obtained. Iron-chromium-carbon alloys were obtained, but it was possible only to obtain iron-manganese alloys with a low manganese content when iron ores mixed with manganese ores were treated in the same way. F. J. B.

2245. Electrolytic Preparation of Magnesium from Fused Fluorides containing Magnesium Oxide. G. Grube [with J. Jaisle]. *Zeits. f. Elektrochem.* 33. *pp.* 481–487; *Disc.*, 487, *Nov.*, 1927. *Paper read before the Deut. Bunsen Gesell., Dresden, May,* 1927.

The triangular freezing-point diagram for mixtures of sodium, barium, and magnesium fluorides indicates the existence of the two compounds, NaF, MgF_2, melting at about 1030°, and BaF_2, MgF_2, and of the three ternary eutectics, $MgF_2 - BaF_2$, MgF_2 — NaF, MgF_2 (850°), BaF_2, $MgF_2 - BaF_2$ — NaF, MgF_2(800°), and BaF_2 — NaF — NaF, MgF_2(750°). The fused mixture having the composition of the last eutectic dissolves the largest proportion of magnesium oxide but yields only sodium on electrolysis by means of an iron kathode and a graphite anode. The 800° eutectic mixture gives sodium and magnesium, the latter with a current efficiency of 22 % to 25 %, whereas the 850° mixture yields only magnesium at 900° with a current efficiency of 50 %, the loss being due to volatilisation and formation of anode fog. T. H. P.

2246. Strong Electrolytes. A. Gyemant. *Phys. Zeits.* 29. *pp.* 289–293, *May* 15, 1928.

Measurements of the electrical conductivity of strong electrolytes in solution in badly conducting organic solvents confirm the view of Nernst that the strong electrolytes are incompletely dissociated. A positive Wien effect was shown to exist, and a constant conductivity was simultaneously observed. These observations lead to the conclusion that the undissociated pairs of ions form only a loosely bound combination, and at high electrical fields they can contribute to the total conductivity.

F. J. B.

2247. Refraction and Dissociation of Electrolytes. I. In Water. E. Schreiner. *Zeits. f. phys. Chem.* 133. 5–6. *pp.* 420–430, *April*, 1928.

The object of the experiments is the comparative study of the dissociation of acids and their salts dissolved in water and in alcohols. The author distinguishes a dissociation of the first kind $AB \rightleftharpoons A^+ + B^-$ from a dissociation of the second kind $A^+ B^- \rightleftharpoons A^+ + B^-$. The refraction of the undissociated molecules is smaller than that of the ions. The fraction of undissociated molecules of the first kind is determined by $(1 - \alpha) = (R_o - R)/(R_o - R_u)$, where R is the refraction of the acid at concentration C, R_o the same for C = O, and R_u the refraction of the undissociated molecules; thus $\alpha = (R - R_u)/(R_o - R_u)$. As deformation would also diminish the refraction with increasing concentration, a dissociation of the first kind is difficult to distinguish from deformation; when the law of mass action is fulfilled, dissociation may be assumed. As regards the undissociated molecules of the second kind, it is striking that most salts, particularly lithium iodate and nitrate, show an almost constant refraction as the concentration increases, although in 2-molar or 4-molar solutions, especially of multivalent salts, undissociated molecules of the second kind should exist. It would thus appear that incompletely dissociated molecules of the second kind do not affect the refraction, *i.e.*, they have the same refraction as the sums of the free ions. The measurements are made at 18° with a Zeiss-Pulfrich refractometer of new design on the sodium D line and the hydrogen lines C and F, the substances being trichloracetic acid and its Na and Li salts, and hydrochloric acid and its Li salt. The values for α by the optical method and the conductivity methods agree well up to concentrations of 2 mol.; at higher concentrations the optical method gives greater values. The molecular refraction of the trichloracetic acid decreases as the concentration increases, those of the salts are constant. In the case of HCl and LiCl the refractions decrease, but the curves are not quite straight, the first decrease being small. H. B.

2248. Observations on the Passivity of Metals. E. S. Hedges. *Chem. Soc., J. pp.* 969–978, *April*, 1928.

Reference is made to the work of Evans, and one of the objects of this paper is to show, by the use of methods which do not involve the removal of the metal from the acid, such as the "whirling" method, that iron rendered passive by nitric acid also has a protective oxide film. The results obtained by the whirling of passive iron in the lowest concentration of nitric acid necessary to passivate electrolytic iron are in accordance with this theory and at variance with the theory of Smits. It is shown that passive iron becomes activated at 74·5°–75·5° C. when heated in concentrated nitric acid, the dissolution of the metal being independent of the concentration of the acid. This temperature corresponds to that at which freshly ignited ferric oxide begins to dissolve in concentrated nitric acid, and it is also shown that this temperature does not represent an allotropic change in the metal. The passivity produced by anodic polarisation and by chemical means are shown to be the same phenomenon, *i.e.*, the result of the formation of a film of oxidised material. A theory of the mechanism of anodic polarisation is advanced. J. K.

2249. Study of Magneto-Electrolytic Potentials. E. O. Holmes, Jr., and A. Handy. *Am. Chem. Soc., J.* 50. *pp.* 1303–1314, *May*, 1928.

The authors refer, among others, to Scarpa, who believed that the existence of magneto-electrolytic potentials in solutions containing certain dissolved electrolytes proved the presence of free electrolytic ions. The term magneto-electrolytic potential is used for that potential difference developed at right angles to the direction of flow and that of the field when solutions of electrolytes flow through magnetic fields. It is found that the potential difference is independent of the concentration and nature of the dissolved electrolyte, but is proportional to its linear velocity and the field strength. Scarpa believed that if a flowing solution containing dissolved electrolyte actually contained free ions, they would be forced to opposite sides of the stream in a magnetic field, causing in this way a potential difference. The above results, however, can be explained as a case of metallic conduction in solutions of electrolytes and to obey the rule of the dynamo, and it may also equally well be explained upon the assumption that the ions are displaced. No conclusive evidence, however, of the actual displacement of an ion is given. The conductivity of a solution in a stationary state and when flowing through a magnetic field is found to be the same, showing that ions are not created by magnetic dissociation of the molecules. J. K.